Essays in Urban Economics

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Abstract

In this set of essays, I grapple with issues related to the core questions of urban economics. Why are people so heavily clustered in urban areas? Why do some cities grow while others decline? What explains where people live within urban areas? My first essay focuses on understanding patterns of racial segregation within metro areas. One factor that has long been hypothesized to contribute to this divide, but has proven difficult to test empirically, is that local zoning regulations have an exclusionary impact on minority residents in some neighborhoods. I focus on variation in block-level racial composition within narrow bands around zone borders within jurisdictions. My results imply a large role for local zoning regulation, particularly the permitting of dense multi-family structures, in explaining disparate racial location patterns. The second essay returns to core issues of agglomeration and the role of cities. The fact that wages tend to be higher in cities, and that this premium grows with density, has been seen as strong evidence for urban agglomeration forces enhancing productivity. In modern data this density premium seems only to exist in areas with above average levels of human capital. Agglomeration models emphasizing learning and knowledge spillovers between workers in close proximity seem most compatible with the data. Finally, I investigate the impact of local governance structure on urban growth over the last 40 years. Some economists have touted the virtues of competition between fragmented local governments in efficient provision of local public goods, while regionalists have pointed to the need to coordinate planning and infrastructure across jurisdictions, and warned of the impacts of fractionalization on segregation and sprawl. While cities with regionalized governments have grown more rapidly, a small set of strong historical correlates with local government density can account for this. Impacts on segregation are more robust.

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Introduction

Why do people live where they do? No question is more central to the field of urban economics, and to my mind it remains one of the most compelling questions in all of economics. Finding an answer first requires confronting the overwhelming clustering of people in urban areas. What makes cities and suburbs so attractive to people and firms? Why has this attraction grown over time?

Moving beyond the urban-rural divide, cities have their own unique characters. Why do some cities grow while others decline? Are these paths determined by external economic forces, or do local governments play a role in determining their fate?

Finally, what determines the internal structure of a city? Why do some cities sprawl while others maintain more compact footprints? Why do we see high levels of segregation between people of different races and classes?

In the three essays in this dissertation I grapple with issues related to each of these three fundamental questions of urban economics. First, I explore the implications of land use restriction on racial segregation within Massachusetts metro areas. More than fifty percent of the black population in the Boston metro area would have to move in order for there to be an equal distribution of blacks and non-blacks across the region. What explains this high level of segregation within an urban area? One factor that has long been hypothesis to contribute to this divide, but has proven difficult to test empirically, is that local zoning regulations in many neighborhoods have an exclusionary impact for some minority residents. Using detailed spatial data available for all municipalities in Massachusetts I am able to provide some of the best empirical evidence to date on the impact of density zoning regulation on location choices by race. Capitalizing on the geographic detail in the data, I focus on variation in block-level racial composition within narrow bands around zone borders within jurisdictions, mitigating omitted variable concerns that arise in studies focusing on larger geographic units. My results imply a large role for local zoning regulation, particularly the permitting of dense multi-family structures, in explaining disparate racial location patterns.

The second essay backs away from the within region questions and examines the role that human capital plays in explaining urban clustering. One compelling explanation for why humans cluster in cities is because their proximity makes them more productive. The fact that wages tend to be higher in cities, and that this premium grows with density, has often been taken as strong evidence for urban agglomeration forces being important in explaining per worker productivity. As Edward L. Glaeser and I point out in this essay, in modern data this density premium seems only to exist in urban areas that also have relatively high levels of human capital. What can explain this complementarity between cities and skills? We argue that learning models emphasizing knowledge spillovers between workers who live in closer proximity seem most compatible with the data.

Finally, I investigate the role of the structure of local governance in explaining why some cities have grown faster than others over the last 40 years. Many economists, starting with Tiebout, have touted the virtues of competition between jurisdictions in fragmented metropolitan areas in promoting efficient provision of local public goods. Regionalists have pushed back against this, pointing to the need to coordinate land use planning and investments in infrastructure across jurisdictions, and warning of the impacts of fractionalization on segregation and sprawl. Due to the remarkable permanence of municipal and town governments over the past half century, these hypotheses can be tested by looking at urban performance across US metro areas over the last 40 years where levels of government fractionalization differ substantially. Though disentangling impacts proves difficult, it appears that arguments for regionalism based on the strong performance of regionally governed areas over this period are weakened substantially by controlling for a small set of variables with strong historical correlations with local government density. Comparing the internal structure of cities with different types of governance, I find that impacts on sprawl are similarly difficult to detect, while positive correlations between fractionalization and growth in racial segregation and the share of the population with a bachelor's degree seem more robust to the inclusion of controls.

I hope that these three papers will contribute to our understanding of the role that zoning, human capital and local governance play in determining where people and economic activity locate in space.

Chapter 1

The Impact of Land Use Regulation on Segregation: Evidence from Massachusetts Zoning Borders

1.1 Introduction

Since the advent of mass suburbanization in the middle of the 20th century, the racial geography of most American metropolitan areas has followed a familiar pattern. Black and Hispanic households reside in neighborhoods proximate to the dense urban core, with the population of each subsequent ring of suburbs becoming whiter and more sparsely populated. Even as racial segregation may have peaked (Glaeser and Vigdor, 2012) and minority suburbanization has drawn increased attention (Weise, 2004), the relationship between the black population and residential density remains striking, particularly in Northern and Midwestern cities.

Density is not merely the outcome of a decentralized housing market. Local zoning regulations have played a key role in keeping lot sizes large and multi-family housing rare in many jurisdictions. As the prevalence of restrictive zoning regulations increased in the 1960s and 1970s, the question arose among economists and other urban scholars whether such laws were causing increased racial segregation. While the letter of the law was exclusionary only towards certain classes of residential land use, many hypothesized that the true impact extended towards exclusion of classes and races of people. In some cases historians have documented that such outcomes were in fact the intent of the laws, pointing towards jurisdictions enacting such regulation in the wake of Supreme Court cases striking down communities' abilities to enforce racial segregation through public regulation in 1917 or private restrictive covenants in 1948 (Danielson, 1976).

Regardless of the intent of such laws, the causal impact of zoning regulation on residential segregation remains an open empirical question. Though the strong correlation between density and minority concentration is readily apparent in population data, the relative scarcity of comprehensive zoning datasets has made gaining traction on the question difficult. The types of statutes used to restrict building differ considerably across jurisdictions, leaving researchers with a maze of lot size restrictions, frontage and setback regulations, floor to area ratios, and specific use prohibitions coupled with procedures for negotiating allowances through layers of local bureaucracy. Fortunately, in recent years researchers and government agencies have compiled comprehensive and navigable land use restriction datasets that make progress on this question achievable.

Taking advantage of particularly detailed spatial data made available to the public by the Massachusetts Office of Geographic Information (MassGIS) I am able here to assess the impact of zoning restrictions on minority population shares at the block level within jurisdictions in the major metropolitan areas of Massachusetts. The geographic detail of the data allows me to conduct an analysis of the impact of zoning regulation on minority population shares on either side of borders where land use regulation changes.

My focus on the impact of narrow spatial variation in land use restriction allows me to circumvent many of the omitted variable concerns that arise at higher levels of geographic aggregation. While zoning regulation may be one of the driving forces of racial segregation, there are many other factors that drive minorities and whites to live in different communities. Racial residential location could be influenced by historical settlement patterns that developed in the aftermath of the great black migration of the early 20th century and subsequent white suburbanization, by access to public transportation, differing willingness and ability to pay for local amenities and public goods, housing discrimination or decentralized racism. To the extent these factors differ between places with high and low levels of land use regulation, estimates of the impact of such laws may be confounded.

By zeroing in on differences in racial population shares along narrow bands on either side of within jurisdiction zoning borders I am able to minimize the impact of these other city and neighborhood factors that should vary more continuously across the boundary. Though some caution is warranted in taking these boundaries as exogenous to racial population shares, I argue that such concerns are lessened given the consistency of these laws over long time periods, and my ability to restrict the dataset to boundaries not coincident with other natural and manmade features.

Using this border design I find robust evidence that land use regulation does negatively impact minority population shares on more restrictively zoned blocks in the 2010 Census. Increasing the allowable density by five dwelling units per acre, roughly the standard deviation in Massachusetts metropolitan areas, increases the block's black share by 1.9 percentage points and the Hispanic share by 2.5 percentage points, over a quarter of the mean level of each group. The impact of by right allowance of multi-family housing is particularly strong for both groups, and this is as true in the suburbs as the urban core. Permitting multi-family housing leads to a 3.36 percentage point higher black share and a 5.77 percentage point increase in the Hispanic share.

The impact, particularly for Hispanics, has grown stronger over the last 20 years and land use regulation is strongly predictive of growth in block-level minority shares between 1990 and 2010. I conclude by extrapolating these findings to the metro area level, finding that equalizing zoning across the Boston Metro Area could more than halve the gap between heavily zoned Boston and lightly zoned Houston on a common segregation measure. These results strongly confirm the hypothesis that zoning negatively impacts racial integration, while suggesting caution in interpreting the even larger impacts found in cross-MSA studies.

The paper proceeds as follows: In Section 1.2 I discuss two previous empirical contributions to this literature. Section 1.3 discusses the MassGIS and Census data used here. In Section 1.4 I provide a simple model to motivate the empirical work and suggest mechanisms by which land use regulation might affect segregation. Section 1.5 presents the main results, Section 1.6 offers discussion and Section 1.7 concludes.

1.2 Existing Evidence on the Impact of Land Use Restrictions on Segregation

The hypothesis that restrictive zoning may lead to decreased minority residence in more prohibitive areas and greater overall segregation has long been present in the economics literature (e.g. Downs (1973); Fischel (1985)). Rigorous empirical examination of the hypothesis has only been undertaken more recently. Pendall (2000) compiled a dataset with the intent of examining this question, gathering survey responses from planning directors in 1168 jurisdictions across the 25 largest US metropolitan areas. He estimates that jurisdictions allowing only what he defined as low-density housing (no more than 8 units per acre) had less than half the black populations of those without such controls and only 60 percent as large a Hispanic populations in 1980. Furthermore, the growth in minority populations was lower for jurisdictions allowing only low-density housing, with the black and Hispanic populations growing 0.8 and 0.5 percentage points more slowly, respectively.

Building on an updated version of Pendall's data (Pendall et al., 2006) as well as incorporating data from the Wharton Land Use Regulation Index (Gyourko et al., 2008), Rothwell and Massey (2009) study the impact of zoning restrictions on metro area level segregation across the largest 49 US metro areas. To quantify segregation they use dissimilarity index, a metric defined over two racial groups that measures the percentage of one group that would need to move to ensure a uniform share of that group across the area. They find that increasing the maximum allowable density by one standard deviation decreases the dissimilarity index of a metro area by between four and seven percentage points in the 1990 and 2000 cross-sections, depending on the OLS specification. Their point estimate implies that moving from one end of the distribution to the other would lower the dissimilarity index by 25 percentage points. Instrumental variables show a slightly larger effect, with a point estimate of 8 percentage points for a standard deviation change. They also show that a standard deviation higher level of maximum density is associated with an 8 percentage point higher (less negative) change in the dissimilarity index between 1980 and 2000 with most of the effect concentrated in the earlier part of the period, and this is fairly similar between the OLS and the IV regressions.

These findings lend credence to the hypothesis that restrictive zoning might have quite large effects on racial segregation, but some caution is warranted. While both sets of authors are well aware that other differences may exist between places with strict and lax zoning regimes, their data allow limited investigation of potential omitted variables bias. In the case of Rothwell and Massey, one might worry that the instrument of year of statehood, which is nearly collinear with region effects, might be acting on segregation through any number of mechanisms beyond density zoning. The regional patterns in the dissimilarity index are striking - for instance, the top 9 most segregated metro areas in the 2010 Census are all in the "rust belt" region of the upper Midwest (Glaeser and Vigdor, 2012), suggesting a role for other channels such as disparate impacts of the Great Migration of blacks from the South in the early 20th century (see, for instance, Boustan (2010)). While Rothwell and Massey argue that the density result holds within regions when they run the regressions separately, isolating the effect of zoning across metro areas remains challenging.

1.3 The MassGIS Zoning Data

The data for this project come from the State of Massachusetts's Office of Geographic Information (MassGIS). The spatial data available from MassGIS span a broad set of topics including economic and housing development, transportation, natural features, local governmental boundaries and the environment. This study focuses primarily on the zoning data, which was compiled by MassGIS from maps sent in by each town's government or planning agency around the year 2000 . The data include polygons with the precise boundaries of each zone as well as the written bylaws corresponding to that zone and a series of coded variables derived from these bylaws. As town zoning bylaws can differ substantially in intent and wording between jurisdictions, compiling uniform spatial data with this level of detail and geographic scope is quite rare - in fact I know of no other state that makes such data available. The data is described extensively and explored by Wheaton and Evenson (2003) and has been used by Zabel and Dalton (2011) to examine the effect of zoning on housing prices.

The main variables used in this study are derived from the "primary use" variable, which classifies zones to one of 21 categories including 9 residential categories, 5 commercial categories, 2 industrial categories, 2 institutional categories, a mixed use category, an unzoned category and a category for land preserved for conservation or recreation. Within residential, the primary focus here, three multi-family housing categories separate land zoned for multi-family structures with densities of 3 to 8 dwelling units, 9 to 20 units and greater than 20 units per acre. The remaining six categories break down single family or duplex housing by minimum lot size, varying from a low category of 5,000 to 15,000 square feet (3 to 8 units per acre) to the largest category of 80,000 square feet and above (at least 2 acres per lot) as well as a category for mixed low density agricultural and residential. Importantly, residential areas are coded by their densest possible use by right, that is, the densest structures that can be built without special permitting. In practice some local zoning boards are more lenient than others in granting allowances, but this coding allows an exploration of the effect of zoning laws as written, rather than as they have being interpreted over time, a variable more likely to be exogenous to current local conditions.

The main dependent variables come from race data at the block level taken from 2010 US Census 100 percent sample (Summary File 1) geocoded using the Census Tiger shapefiles. Census blocks are the smallest unit of geography available to the public and data are available at this level for only a small set of variables: populations by age, sex, race, Hispanic origin, household type and whether the housing unit is owned or rented. Blocks are delineated by roads or geographic features, and vary in size depending on population density. Urban blocks tend to encompass literal blocks, surrounded on all four sides by adjacent roads, whereas rural blocks can be substantially larger. Not all blocks are populated - some, for instance, are entirely covered by water. These unpopulated blocks are dropped from the analysis. Of those with non-zero populations, the blocks in Massachusetts metropolitan areas used here range from 1 to 4025 people with a median of 44 people and correspond to land areas between 0.02 and 5157 acres, with a median of 5.62 acres.

I overlay the blocks onto the zone data and classify each block by primary use if at least 90 percent of the block shares the same designated land use. I have probed the robustness of cutoffs from 75 percent up to 99 percent and the results are broadly similar. The threshold presents a tradeoff - a lower threshold introduces measurement error biasing the results downwards, but a higher threshold lowers sample size, reducing power. The 90 percent threshold tends to yield similar point estimates to higher values without compromising power, whereas lower thresholds show more severe attenuation. With the 90 percent threshold about 23 percent of blocks cannot be categorized as having a single use, with 70 percent falling into one of the nine residential categories and the remaining seven percent having either commercial, industrial, institutional or conservation uses.

The first column of Table 1.1 shows summary statistics for populated blocks in Massachusetts metropolitan areas. The majority (63.13 percent) of the blocks are in the Boston metro area, but blocks from Worcester, Springfield and the Massachusetts portion of the Providence metro area are also included. The population is 6.96 percent percent black, 10.08 percent Hispanic, and 75.05 percent non-Hispanic white.[1] The three races have strikingly different rates of renting versus owning, with blacks (66.53 percent) and Hispanics (75.44 percent) renting at over twice the rate of whites (31.67 percent).

In terms of land use, 6.52 percent of blocks are zoned for multi-family residential use with most of that being denser than 8 units per acre. The 63.25 percent of land zoned for single family use is spilt roughly evenly between what I define as low (lot sizes over an acre), medium, and high (less than 3/8 of an acre lot sizes) density uses. I construct a linear measure of zoning by taking the 9 categorical measures of residential zoning and assigning each the average dwelling units per acre observed in the data for that category. This measure varies from 0.5 to 22 units per acre with a mean of 4.21 and a median of 4.73.

To ensure comparability between blocks in my sample, I employ several selection criteria. Starting with 82,071 blocks, I drop those with non-residential or split land use (23,079 blocks), with anyone housed in group quarters (2,724 blocks), with any public housing (687 blocks), with land areas greater than 160 acres, equivalent to a square quarter mile (3,074 blocks) and where more than ten percent of the land area is covered by water (146 blocks). It is from this remaining set of 52,359 blocks that I draw the border samples.

[1] Black here is defined as black alone, not in combination with other races, and includes Black Hispanics. This is the subgroup for which the most data is available on Census Summary File 1.

Table 1.1: Summary Stats

	All Blocks in Massachusetts Metro Areas			Blocks in Zoning Border Sample			Borders Between Multi-Family & Single-Family			Borders Where Single-Family Density Zoning		
	Total	Share		Total	Share		Total	Share		Total	Share	
Person Level:												
Population	6,102,443			505,402			175,298			255,892		
Black	424,769	0.0696		50,804	0.1005		26,936	0.1537		4,941	0.0193	
Hispanic	614,846	0.1008		46,441	0.0919		23,772	0.1356		8,286	0.0324	
White (Non-Hispanic)	4,580,102	0.7505		360,784	0.7139		103,964	0.5931		227,028	0.8872	
Dwelling Units	2,515,393			210,238			76,494			101,538		
Rental Units	906,254	0.3603		75,976	0.3614		36,671	0.4794		18,244	0.1797	
Black Rental (of Black Total)	98,231	0.6653		11,247	0.6281		5,532	0.5916		716	0.4295	
Hispanic Rental (of Hisp Tot)	136,049	0.7544		10,087	0.7323		5,336	0.7460		1,052	0.4804	
White Rental (of White Total)	594,898	0.3167		47,754	0.3137		22,244	0.4557		15,464	0.1748	
Block Level:												
Blocks	82,071			6,835			1,959			4,314		
Boundaries				1,328			414			796		
No Black Population	51,663	0.6295		4,154	0.6078		766	0.3910		3,308	0.7668	
No Hispanic Population	40,379	0.4920		3,178	0.4650		575	0.2935		2,566	0.5948	
Has Body of Water	6,375	0.0777		353	0.0516		25	0.0128		329	0.0763	
Zoned for Multi-Family	5,354	0.0652		1,520	0.2224		932	0.4758		0		
Multi-Family High Density	4,438	0.0541		1,160	0.1697		638	0.3257		0		
Multi-Family Low Density	916	0.0112		360	0.0527		294	0.1501		0		
Zoned for Single-Family	51,907	0.6325		5,315	0.7776		1,027	0.5242		4,314	1.0000	
Single-Family High Density	19,248	0.2345		2,007	0.2936		867	0.4426		1,153	0.2673	
Single-Family Med. Density	15,570	0.1897		2,222	0.3251		112	0.0572		2,118	0.4910	
Single-Family Low Density	17,089	0.2082		1,086	0.1589		48	0.0245		1,043	0.2418	
	Mean	Median	St. Dev.	Mean	Median	St. Dev.	Mean	Median	St. Dev.	Mean	Median	St. Dev.
Population	74.36	44	103.85	73.94	51	77.28	89.48	67	87.25	59.32	40	63.33
People Per Acre	12.77	6.43	27.95	13.97	7.34	19.84	22.84	18.45	23.82	6.09	4.49	9.28
Dwelling Units Per Acre	5.61	2.64	15.65	6.12	2.92	10.16	10.24	7.84	12.38	2.57	1.76	5.41
Rental Units Per Acre	2.69	0.19	10.37	2.91	0.27	7.53	5.30	2.69	10.31	0.62	0.06	2.59
Zoned Units Per Acre	4.21	4.73	4.02	5.69	4.73	5.84	9.00	4.73	6.24	2.66	1.94	1.44
Land (acres)	39.71	5.62	131.13	16.52	5.51	27.64	6.68	3.61	12.51	22.85	8.54	32.21
Dist to City Center (miles)	17.34	15.19	12.42	15.52	13.41	10.95	12.55	7.43	12.11	17.60	15.94	9.60

Notes: Population data are calculated using the 2010 US Census Summary File 1, an 100% sample of the US population. Geographic and zoning data are constructed using GIS shapefiles available from MassGIS.

To construct my border samples I classify a block as falling on a zoning border if it intersects a 50 meter band drawn around a boundary where the type of permitted residential land use changes. I use only borders within towns, and omit those that fall along highways, streams or railroad tracks, as such barriers may serve as natural neighborhood dividing lines, and I want to ensure that blocks on both sides of the border have similar neighborhood characteristics (see, for instance, Ananat (2011) for an exploration of the role of historical railroad lines in demarcating racial neighborhood boundaries.)

As an example, Figure 1 shows zoning regulation for Cambridge, Massachusetts and blocks identified as being on zoning borders. Like most inner suburban areas, Cambridge residential land use is split between multi-family housing and high density single-family housing. From the map we can see that the south and east of the city are largely zoned for multi-family housing and commercial while the north and west have mostly single-family zoning. Given that differences may exist between the two regions of the city, such as historic settlement patterns, access to popular commercial areas, parks and universities, and proximity to heavier industry, we would not expect differences in composition between the two to be driven entirely by land use regulation. However, focusing on the outlined blocks, it is more plausible that the differences in block composition one sees when crossing one of the dark black borders is a result of the differential land use on either side.[2]

Figure 2 shows the distribution of the black population in Cambridge, and similarities between the two figures do suggest that the black population is more heavily concentrated in areas with multi-family zoning. However, focusing on variation across borders where neighborhood characteristics are held constant, patterns are harder to discern from cursory inspection.

Returning to Table 1.1, three main border samples are used in the analysis. Column 2 shows descriptive statistics for blocks that lie on any zoning border where residential land use changes. These blocks are broadly similar to the full set of metro Massachusetts blocks, though somewhat more black (10.05 percent), more concentrated in the Boston metro area and more likely to be zoned for multi-family housing.

[2] Not all blocks surrounding borders are outlined due to those blocks failing one of the sample selection criteria. Generally these blocks either have zero population, a positive group quarters population, or are split between two land use categories.

Figure 1: Zoning Regulation in Cambridge, MA

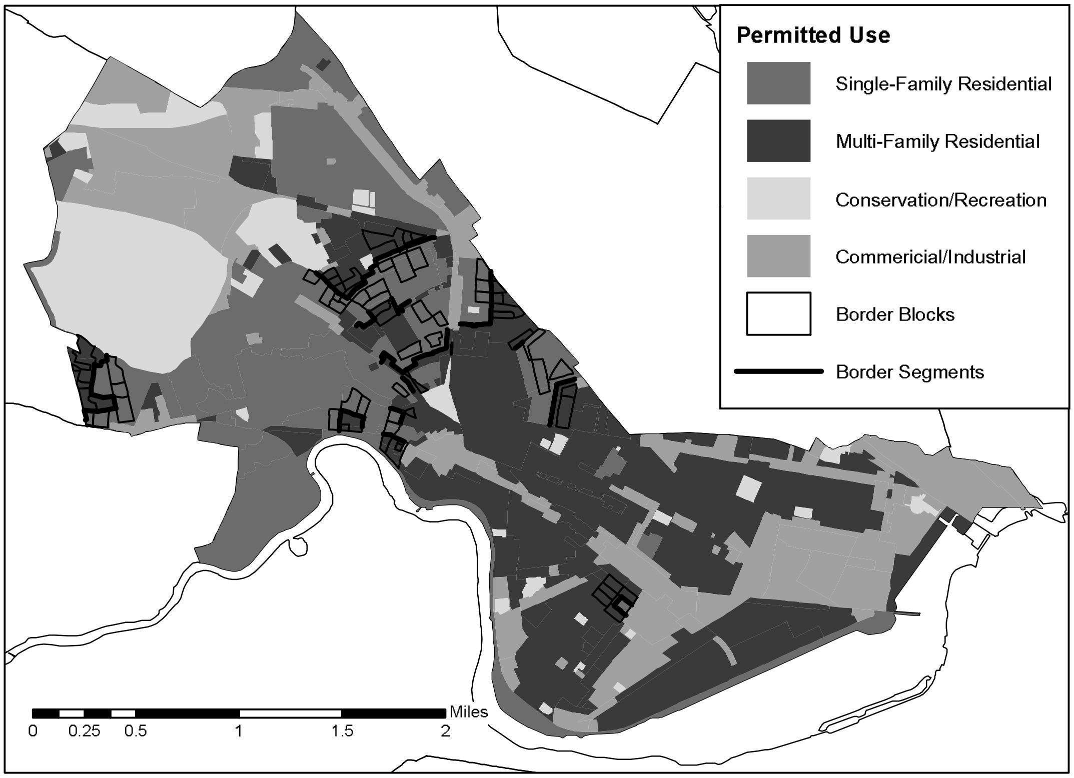
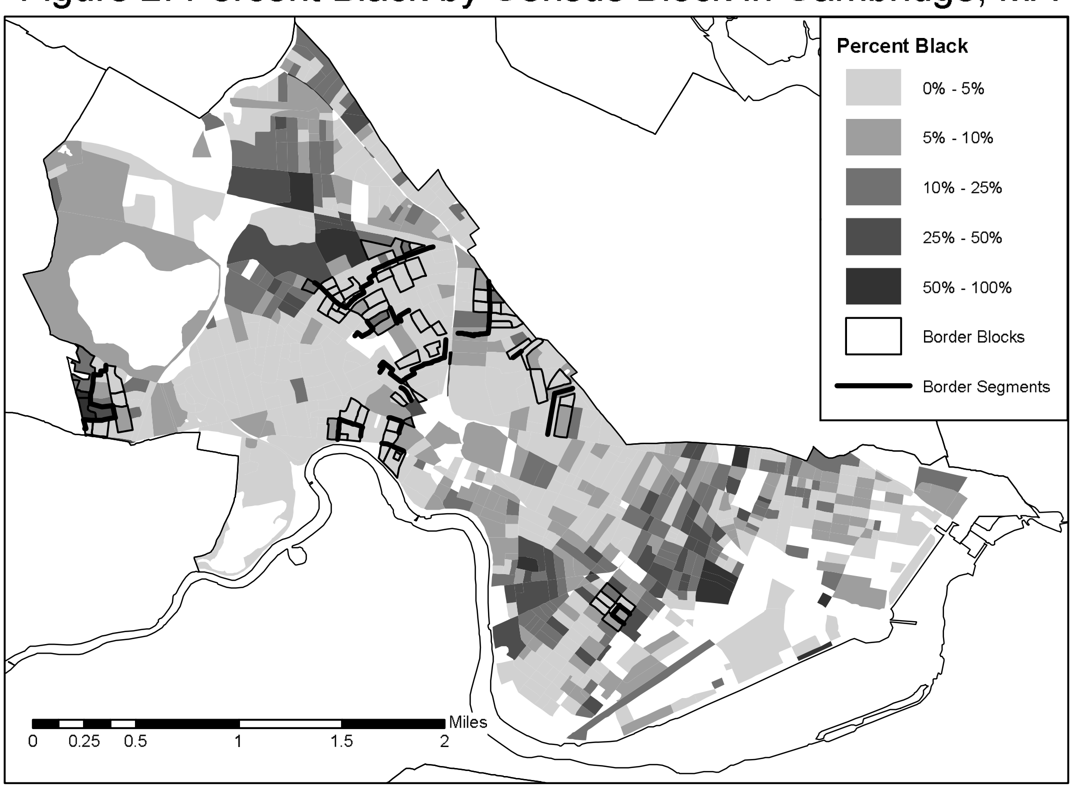


Figure 2: Percent Black by Census Block in Cambridge, MA



The third and fourth columns look at two important subsets of the border sample. Column 3 shows blocks on either side of boundaries where land use changes between single-family residential and multi-family residential. These blocks have considerably larger minority populations, both for blacks (15.37 percent) and Hispanics (13.56 percent). They are also more densely populated, have more rental units per acre, are smaller in land area, closer to major city centers and particularly concentrated in Boston's urban core, defined here as Boston and the 9 suburban communities that lie within 5 miles of the city center.[3] The fourth column gives statistics for the sample comprised of blocks that lie on borders between single-family residential zones with different minimum lot sizes. These blocks have very small minority populations (1.93 percent black and 3.24 percent Hispanic), lower population densities, few rental units, and are more likely to be located along the Route 128 corridor in suburban Boston than in the urban core.

Along with the 2010 Census data, I also use past census block data to examine changes in racial composition over time. Because the spatial scope of census blocks is not consistent across decades, I geographically match blocks using the Census's Tiger Shapefiles. The need for this match limits the analysis to the time period of 1990 to 2010 as spatial data at the block level is not available before 1990. I keep blocks where I can find a set of 1990 blocks that are completely contained within a 2010 block and comprise more than 75 percent percent of the land area of that block, or meet the same criteria fitting 2010 blocks into 1990 blocks. This yields a match rate of about 60 percent for populated blocks.

Finally, I make use of individual tax parcel data from MassGIS to investigate the types of structures present on each block. As with the land use regulations, these data were compiled by MassGIS through submissions from local officials. I use data for the entire Boston metro area with the notable exception of Boston itself, where data is not available.

1.4 A Model of Housing Choice and Density Zoning

Consider the housing market in the Boston metro area (or analogously, the Springfield or Worcester metro areas.) I assume that the market is in static spatial equilibrium such that at

[3]See the Appendix for the set of towns located in each sub-region of Greater Boston.

price vector P* everybody is living in their preferred home; that is, they are maximizing their indirect utility function:

$$V_i(H_j) = f\left(P_j^*\left(X_j, Z_n\right), X_j, Z_n\right) \tag{1.1}$$

where X_j is a vector of attributes of the property such as structure type, housing tenure, lot size, interior amenities and distance to business districts, and Z_n is a vector of neighborhood characteristics such as local amenities and public goods, neighbors and the neighborhood's built environment. Though the functional form of this relationship will not be crucial for the estimation in this paper, to fix ideas I will assume this takes the linear form:

$$V_i(H_j) = -\alpha_i P_j^*\left(X_j, Z_n\right) + X_j\beta_i + Z_n\omega_i + \epsilon_{ij} \tag{1.2}$$

where the coefficients are allowed to differ across individuals. If housing within a block is relatively comparable, we could think of the j subscripts as referencing blocks rather than housing units, and think of this as a function describing people's preferences over consuming a unit of housing on a given block in the Boston area. The land use density restrictions that are of interest here are unlikely to enter the utility function directly. Rather, they affect individual well-being through their equilibrium impacts on the other variables in the utility function. This can be seen in the equation by introducing a small perturbation in density zoning:

$$\begin{aligned} V_i(H_j) = &-\alpha_i\left(\widetilde{P}_j^* + \left(\tfrac{\partial P_j}{\partial D_j} + \tfrac{\partial P_j}{\partial X_j}\tfrac{\partial X_j}{\partial D_j} + \tfrac{\partial P_j}{\partial Z_j}\tfrac{\partial Z_j}{\partial D_j}\right)dD_j\right) \\ &+ \left(\widetilde{X}_j + \tfrac{\partial X_j}{\partial D_j}dD_j\right)'\beta_i + \left(\widetilde{Z}_n + \tfrac{\partial Z_n}{\partial D_j}dD_j\right)'\omega_i + \epsilon_{ij} \end{aligned} \tag{1.3}$$

Rearranging and assuming that the derivatives take a linear form over the relevant range of zoning regulations yields

$$\begin{aligned} V_i(H_j) = &\left(-\alpha_i\delta_{pd} + \delta_{xd}\left(\beta_i - \alpha_i\delta_{px}\right)\right)D_j \\ &+ \delta_{zd}\left(\omega_i - \alpha_i\delta_{pz}\right)D_j - \alpha_i\widetilde{P}_j^* + \widetilde{X}_j\beta_i + \widetilde{Z}_n\omega_i + \epsilon_{ij} \end{aligned} \tag{1.4}$$

One could in principal use a structural approach to modeling these preference parameters by race based on observed racial location patterns (see Bajari and Kahn (2005) for a strategy in this spirit in the context of racial residential preferences) but this would require data from multiple markets with zoning data, or individual level housing data that allowed geographic identification at the zone level. Instead, following Black (1999), I pursue a reduced form strategy taking advantage of the sharp spatial discontinuities created by within-town zoning borders. Underlying this strategy is the assumption that density zoning regulation is the only thing changing at the border. The neighborhood characteristics, as well as the residual attributes and price of the housing stock should remain fixed. Under this assumption, the indirect utility function simplifies to:

$$V_i(H_j) = \left(-\alpha_i\delta_{pd} + \delta_{xd}\left(\beta_i - \alpha_i\delta_{px}\right)\right) D_j + \theta_b + \epsilon_{ij} \tag{1.5}$$

where θ_b is a fixed border effect that absorbs all terms constant at the neighborhood level. Estimating this directly would require assumptions on the error terms that would allow me to convert this into an equation about the observed data, which are racial shares at the block level. Since I'm less interested in the specific preference parameters than I am in the aggregate impact of density zoning, I estimate the simple linear specification:

$$S_{rj} = \gamma D_j + \theta_b + \mu_j \tag{1.6}$$

where S_{rj} is the share of block j that is of race r, γ will be some function of the differences by race in the distributions of the preference parameters α_i and β_i and the zoning impacts on price and housing attributes δ_{pd}, δ_{xd}, and δ_{px}, θ_b represents a zone border fixed effect and μ_j is a mean zero error term that I will allow to be correlated within town but is assumed to be independent across towns.

Although the preference parameters within the γ function cannot be separately identified with this strategy, their presence in the indirect utility function provides a nice summation of the potential mechanisms through which zoning regulation might lead to changes in racial composition. Looking at equation 1.5, the first term, $-\alpha_i\delta_{pd}$ is the direct impact of zoning on price holding other housing and neighborhood characteristics fixed multiplied by a measure of individual price sensitivity that could differ on average across races. In theory this direct impact should be small if units are highly substitutable across blocks, though estimates of the direct price impact of zoning vary in the literature ((Glaeser and Ward, 2009; Zabel and Dalton, 2011)).

The second term, $\delta_{xd}(\beta_i - \alpha_i\delta_{px})$ shows the two channels through which changes in the housing stock that result from zoning regulations affect racial shares. Races might have different preferences β_i, on average, for attributes of housing such as structure type, tenure or lot size.

Alternatively, it might be that the types of housing built on the strictly zoned blocks differ in price from those on the surrounding more less strictly zoned blocks, and that races might be differentially sensitive to that change. Given the differences in average income and wealth across racial groups, it seems quite plausible that this price channel might play a significant role. A common argument for why density zoning is exclusionary is that it prices out poorer people who would like to live on the block but desire a quantity of land below the minimum threshold.

A third term, $\delta_{zd}(\omega - \alpha_i \delta_{pz})$ appeared in equation 1.4, but is absorbed by the border effect in the regression specification. This term represents the impact of zoning induced changes in equilibrium neighborhood characteristics on the racial composition of the neighborhood, first through differing preferences between races for neighborhood characteristics, and second through a price channel if zoning induces neighborhood level changes that alter the price of housing in the neighborhood. Crucially here, any neighborhood changes induced by zoning on one block are assumed to be felt on neighboring blocks regardless of on which side of the zoning border they fall. Therefore, the border design will not identify this mechanism as part of the effect of density zoning regulation. A much studied dimension on which blacks and whites might differ is preferences for the racial makeup of the neighborhood itself. The failure of the border design to detect this effect is one of the main weaknesses of applying the approach in this context, and suggests that the estimates here might be biased downwards compared to the true long run impact of zoning regulation. I will return to a discussion of this issue in the section 1.6.

1.5 The Impact of Density Zoning on Racial Location Patterns

Table 1.2 shows the results of regressions of the black share of the block population on permitted density, as measure by dwelling units per acre. Column 1 provides the estimate of equation 1.6 above, a linear regression of the share of the population that is black on dwelling units per acre with border fixed effects included in the regression, run on the sample of blocks that fall on a zoning border. Standard errors are clustered at the town level, as they are in all subsequent regressions unless noted.

Table 1.2: Black Share of Block Population and Zoned Density in Massachusetts Metro Areas

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Black Share of Block Pop.	Black Share of Block Pop.	No Blacks on Block	Logged Black Share	Black Share of Block Pop.	Black Share of Block Pop.	Black Share of Block Pop.	Black Share of Block Pop.
Zoned Dwelling	0.0038**	0.0036**	-0.0235**		0.0084**	0.0018	0.0036**	0.0017
Units per Acre	[0.0009]	[0.0007]	[0.0037]		[0.0020]	[0.0016]	[0.0008]	[0.0017]
Logged Zoned				0.1746**				
Units per Acre				[0.0465]				
Distance to Major		-0.0039						
City Center		[0.0029]						
Block Contains		0.004						
Body of Water		[0.0045]						
Border Fixed Effects	YES	YES	YES	YES	NO	NO	NO	YES
Town Fixed Effects	NO	NO	NO	NO	NO	YES	YES	NO
Observations	6835	6835	6835	2681	52359	52359	49772	754
R-squared	0.8	0.8	0.19	0.77	0.09	0.31	0.3	0.84
Blocks Included in Regression	All Border Blocks	All Borders Blocks	All Borders Blocks	Borders with Black Pop > 0	All Blocks	All Blocks	Non-Boston Blocks	Boston Border Blocks
Black Share of Sample	0.1005	0.1005	0.1005	0.1658	0.0696	0.0696	0.0465	0.3244

Notes: The unit of observation in all regressions is the block. Blocks are included if they are in a metropolitan area, have a positive population, are zoned for residential use, have zero people living in group quarters or public housing, are less than 160 acres in land area and have less than 10 percent of their area covered by water. A block is part of the border sample if it intersects a band of 50 meters around a zoning border where residential land use changes. Borders that coincide with bodies of water, highways or railroads are omitted from the border sample. Standard Errors are clustered at the town level except column 8 which uses Huber-White robust standard errors. * significant at 5%; ** significant at 1%

The coefficient, significant at the 1 percent level, indicates that an extra unit of density, measured in units permitted per acre, increases the black share on the block by 0.38 percentage points, where the baseline average black share is 7 percent in the overall population and 10 percent in the border sample. This suggests quite large effects of shifts in zoning of plausible magnitudes. For instance, lowering lot sizes from half acre lots to 8000-square foot lots (similar to the average in the densest single family zoning category) would increase the black share by 1.14 percentage points. Permitting of high-density multi-family housing, with densities of over 20 units per acre, would be expected to have extremely large impacts.

In column two I add controls for distance in miles to the metro area's main city center (Boston, Worcester or Springfield) and whether any body of water is present on the block. Both are strong negative predictors of black population in the full sample, but the impact of density zoning on the black population is unaffected by their inclusion in the border regression. Neither show up as significant predictors of the black share, suggesting that the sample is reasonably well-balanced on these dimensions.

My theory gives me little guidance as to the shape of the relationship between race and zoning, so I next fit a logarithmic model to the data. Unfortunately the black population at the block level is frequently zero, so I divide this into two regressions - one to predict the zeros and the other a regression in logs on the non-zero data. Column 3 reports the marginal effects from a probit model of the impact of density zoning on the having no black population. Not surprisingly, more densely zoned places are less likely to have zero black population than less densely zoned blocks across the border from them, though the coefficient of 2.35 percentage points is small when compared to the fact that over 60 percent of blocks in the sample have no black population.

Given this prevalence of zeros, the number of observations in column 4 shrinks considerably. The coefficient I get from regressing the log of the black share on the log of the density measure implies that doubling zoned density increases the black population by 17.46 percent on blocks with positive black populations. This may be a better fit for the data than the linear measure, though interpretation is complicated by the large number of dropped blocks. Zeroing in on the impact at certain points in the distribution is likely to be more illuminating, as I will explore in the next table.

Before turning to that, in columns 5 and 6, I illustrate the impact of the use of the border design by running ordinary least squares in the full sample of Massachusetts metro areas with and without town fixed effects to benchmark the results. The coefficient in standard OLS is over twice the size of the border estimate from column 1, emphasizing that these blocks differ in more than just how they are zoned. Not surprisingly, much of the variation in the share black of the block population can be explained by the tendency of blacks to live disproportionately in jurisdictions clustered in highly urbanized areas with lax density restrictions, as we see by moving to the town fixed effect regression.

However, it is surprising that the town fixed effects estimator shrinks the effect to half the size of the border fixed effects estimator and that this effect is insignificant at conventional levels. This is driven largely by the city of Boston, where the black population is highly concentrated in the south and west of the city which are zoned mostly for low density multi-family and high density single-family housing, whereas the whiter areas closer to the city center are zoned for denser multi-unit high rises. After dropping Boston in column 7 the town fixed effects estimate looks similar to the one from the border design.

Taking Boston on its own in columns 8 and 9, using Huber-White robust standard errors and running OLS in the full sample shows a strong and significant negative coefficient, but the border regressions shows a small and insignificant positive effect. This illustrates the need to focus on narrow variation within neighborhoods rather than within town variation that may be confounded by omitted neighborhood level variables. The confidence interval for the border regression in Boston alone is certainly too large to rule out that the effect may be equal to that of the full sample, though the smaller effect would be consistent with the hypothesis that upzoning in the urban cores of expensive cities may have negative rather than positive effects on the relative size of minority populations. With only one major city center, I lack the data to say anything about this hypothesis.

In Table 1.3 I decompose the effect of the linear zoning measure by focusing specifically on the effect of allowing the construction of multi-family housing by right on the share of black residents on the block. Limiting the sample to borders across which use changes from single to multi-family dwellings leaves 1959 blocks that fall on 414 borders within 61 towns. The blocks are largely concentrated in the major cities of Boston, Springfield and Worcester, in smaller satellite cities such as Brockton, Fall River, Lowell and in inner ring suburbs like Cambridge, Brookline and Quincy. The land use regulation on the single-family blocks is predominately in the highest density category.

Column 1 shows the estimated coefficient of a border fixed effects regression which finds an impact of 3.36 percentage points that is significant at the 1 percent level. This is just over a fifth of the average black population for blocks in this sample. We can break down multi-family housing into low density (up to 8 units per acre), medium density (9 to 20 units per acre) and high density (20 and above.) Column 2 shows that the point estimate is larger when crossing from single family housing to medium and especially high density multi-family housing compared to low density multi-family, though Wald tests can only reject equality of the high and low density coefficients at the 10 percent level. Column 3 instead uses the sample of borders between different classes of multi-family zoned housing and finds that moving from low density multi-family housing (the omitted category) to medium and high density multi-family housing yields sizable positive coefficients, though only the difference between low and high density is significant. These results suggest that the largest differences in racial composition exist not between single and multi-family blocks of similar densities, but rather between low-density multi-family blocks of triple-decker houses and those with medium and high density apartment buildings.

Columns 4 and 5 turn to single family housing borders. A regression of the black share on allowing single family housing in the highest density category (lot size under 15,000 square feet) yields an insignificant coefficient, as does a regression of the black share on the linear density per acre measure used above taken only in the single-family border sample. The confidence interval allows me to rule out an effect in excess of 1.3 percentage points from permitting the densest form of multi-family housing versus lot sizes of over an acre, though given the small average black population in this sample of blocks (1.93 percent) that is not a very restrictive upper bound.

Table 1.3: Black Share of Block Population and Zoning Categories in Massachusetts Metro Areas

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Black Share of Block Pop.	Black Share of Block Pop.	Black Share of Block Pop.	Black Share of Block Pop.	Black Share of Block Pop.	No Blacks on Block	Logged Black Share
Multi-Family	0.0336**						
Housing Permitted	[0.0074]						
Multi-Family Low Density		0.0087	(omitted)				
(3-8 units per acre)		[0.0133]					
Multi-Family Medium Density		0.0369**	0.0388				
(9-20 units per acre)		[0.0118]	[0.0221]				
Multi-Family High Density		0.0565**	0.0497*				
(20+ units per acre)		[0.0179]	[0.0171]				
Single-Family Low Density				(omitted)			
(lot size > 1 acre)							
Single-Family Medium Density				0.0004			
(lot sizes btw 3/8 and 1 acre)				[0.0045]			
Single-Family High Density				0.003			
(lot sizes < 3/8 acre)				[0.0051]			
Zoned Dwelling					0.0007	-0.0165	
Units per Acre					[0.0012]	[0.0135019]	
Logged Zoned							0.1648
Units per Acre							[0.1359]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Observations	1959	1959	663	4314	4314	4314	1006
R-squared	0.8	0.8	0.84	0.36	0.36	0.12	0.64
Blocks Included in Regression	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Multi-Family Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	SF Bord. Black Pop > 0
Black Share of Sample Pop.	0.1537	0.1537	0.2701	0.0193	0.0193	0.0193	0.0484

Notes: The unit of observation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Columns 1 and 2 use blocks that fall on a border between a single-family zone and one zoned for multi-family units. Column 3 shows blocks on borders of multi-family zones of different densities. Columns 4 through 7 use blocks on borders between single-family zones of different densities. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

Running a regression of the log share on log density in only the single-family sample also yields an insignificant coefficient, though the point estimate of 0.16 log points is very similar to the one found in the full sample. Though I cannot rule out substantial percentage gains as a result of changes in density regulation, given the small initial share of blacks in the sample, even at the upper end of the confidence interval, large changes in minimum lot size regulations are likely to have at most modest impacts on the measured segregation of the black population.

Table 1.4 repeats the same set of regressions from Table 1.1 for Hispanics rather than blacks. The patterns are largely similar, though the effects are slightly larger. An increase in allowable density of one unit per acre corresponds to a 0.5 percent percentage point increase in the Hispanic share of the block population, which averages 10 percent in the population and 9.2 percent in the border sample. This is unaffected by the inclusion of controls for distance to the city and presence of bodies of water. Turning to a logarithmic specification again requires dropping a large portion of the sample because 46.5 percent of border blocks lack any Hispanic population, but within the set of blocks that do have positive population, a 10 percent increase in zoned units per acre leads to a 2.1 percent increase in the Hispanic share on the block. These effects are roughly half the size of the effect of running OLS in the full sample without border fixed effects, and smaller than town fixed effects estimates as well, again emphasizing the importance of narrowly focusing on variation less confounded by town and neighborhood differences.

In Table 1.5 I decompose these effects between multi-family and single-family zones, and find again that multi-family housing is driving the bulk of the impact. In the sample of borders where zoned use changes between single-family and multi-family use, crossing the border to the multi-family side yields a 5.77 percentage point impact in the Hispanic share, which is 43 percent of the 13.56 percent mean Hispanic population in this sample of blocks. That is roughly twice the size of the impact measured for the black share in Table 1.3.

Table 1.4: Hispanic Share of Block Population and Zoned Density in Mass. Metro Areas

	(1) Hispanic Share of Block Pop.	(2) Hispanic Share of Block Pop.	(3) No Hispanics on Block	(4) Logged Hispanic Share	(5) Hispanic Share of Block Pop.	(6) Hispanic Share of Block Pop.
Zoned Dwelling	0.0050**	0.0049**	-0.0195**		0.0098**	0.0078**
Units per Acre	[0.0009]	[0.0009]	[0.0040]		[0.0016]	[0.0017]
Logged Zoned				0.2077**		
Units per Acre				[0.0514]		
Distance to Major		-0.001				
City Center		[0.0009]				
Block Contains		0.0004				
Body of Water		[0.0032]				
Border Fixed Effects	YES	YES	YES	YES	NO	NO
Town Fixed Effects	NO	NO	NO	NO	NO	YES
Observations	6835	6835	6835	3657	52359	52359
R-squared	0.64	0.64	0.16	0.62	0.12	0.42
Blocks Included in Regression	All Border Blocks	All Borders Blocks	All Borders Blocks	Borders with Hisp Pop > 0	All Blocks	All Blocks
Hispanic Share of Sample	0.0919	0.0919	0.0919	0.1213	0.1008	0.1008

Notes: The unit of observation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

Table 1.5: Hispanic Share of Block Population and Zoning Categories in Mass. Metro Areas

	(1) Hispanic Share of Block Pop.	(2) Hispanic Share of Block Pop.	(3) Hispanic Share of Block Pop.	(4) Hispanic Share of Block Pop.	(5) Hispanic Share of Block Pop.	(6) No Hispanics on Block	(7) Logged Hispanic Share
Multi-Family	0.0577**						
Housing Permitted	[0.0122]						
Multi-Family Low Density		0.0344*	(omitted)				
(3-8 units per acre)		[0.0146]					
Multi-Family Medium Density		0.0630**	0.0324				
(9-20 units per acre)		[0.0192]	[0.0250]				
Multi-Family High Density		0.0753**	0.0596*				
(20+ units per acre)		[0.0229]	[0.0186]				
Single-family Low Density				(omitted)			
(lot size > 1 acre)							
Single-Family Medium Density				0.0031			
(lot sizes btw 3/8 and 1 acre)				[0.0028]			
Single-Family High Density				0.0137			
(lot sizes < 3/8 acre)				[0.0074]			
Zoned Dwelling					0.0033	-0.0485**	
Units per Acre					[0.0018]	[0.0135]	
Logged Zoned							0.0475
Units per Acre							[0.0937]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Observations	1959	1959	663	4314	4314	4314	1748
R-squared	0.63	0.64	0.64	0.3	0.29	0.11	0.46
Blocks Included in Regression	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Multi-Family Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	SF Bord. Hisp. Pop > 0
Hispanic Share of Sample Pop.	0.1356	0.1356	0.1859	0.0324	0.0324	0.0324	0.0521

Notes: The unit of observation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Columns 1 and 2 use blocks that fall on a border between a single-family zone and one zoned for multi-family units. Column 3 shows blocks on borders of multi-family zones of different densities. Columns 4 through 7 use blocks on borders between single-family zones of different densities. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

Column 2 decomposes the effect into three classes of multi-family housing and finds a significant effect of moving from single-family housing to any of the three multi-family categories. The impacts are larger in all categories than the effects seen for the black share, but particularly striking is the comparative size of the low-density multi-family impact. For the black population this effect was indistinguishable from zero, and the point estimate was below 1 percentage point, whereas for Hispanics the effect is 3.4 percentage points and significant at the 5 percent level. The coefficients for medium and high density multi-family housing are higher, though a Wald test cannot reject equality between any pair of coefficients. Column 3 shows that at borders where multi-family use changes I can detect an impact of moving from low-density to high-density multi-family housing. Again, these results suggest that permitting medium and high density multi-family housing leads to particularly large increases in the Hispanic share, but for the Hispanic population, in contrast to blacks, zoning for low-density multi-family neighborhoods, which in Massachusetts generally means triple-decker three-family housing, also leads to significant increases in the population share.

Turning to single-family housing, Column 4 shows the impact of moving from low-density (lot sizes one acre or larger) single-family zoning to medium and high-density (lot size less than 3/8 of an acre) single-family housing. The coefficient for high-density single-family is approaching significance at the 5 percent level (p-value of .064) and the point estimate suggests an impact of 1.37 percentage points where the average Hispanic share in this sample of blocks is 3.24 percent.

Again, comparing the magnitude to the impacts seen for the black population, the size of the Hispanic coefficients suggest that changes in land use regulation can have impacts on the Hispanic share at lower density levels than would be expected for the black population. Nonetheless, given the small initial Hispanic populations on blocks bordering low-density single-family zoning, it seems unlikely that changes in minimum lot size regulations would have large impacts on the overall levels of segregation in Massachusetts metro areas.

Some fair housing advocates have pointed to the restrictive land use regulation along the relatively affluent Route 128 corridor in Boston as having had particularly strong effects in limiting the growth of suburban minority populations (Morse, 1975). Of course it could be that even in the absence of restrictive land use regulation these towns would have low minority populations. To investigate, I break the Boston portion of my sample down into four sub-regions, one Boston and 9 inner ring suburbs comprising the urban core, one for the Route 128 Corridor covering the west and northwest suburbs, and one each for suburbs north and south of the city excluding some of the more distant shoreline communities that share little in common with the neighboring jurisdictions. For a list of the cities included and a brief discussion of the construction of each region see the Appendix.

In Table 1.6 I break down the impact of zoning on segregation within these 4 regions. The upper half of the table shows the impact of permitting multi-family housing on minority populations in the sample of borders where land use changes from single to multi-family residential. The impact on the black share is remarkably consistent across regions, always falling between 3 and 5 percentage points. This is somewhat surprising seeing as the mean black population in the four regions differs substantially, and suggests that permitting multi-family housing in any part of the metro area is likely to have strong positive impact on the size of the black population. The coefficient for the Hispanic population differs more between the four regions. Not surprisingly it is largest in the North suburbs where concentrations of Hispanics are already high.

The bottom half of the table shows the impact of different classifications of single family housing. As would be expected from the earlier tables, the impacts are small and generally indistinguishable from 0, though impacts look slightly larger for both minority groups in the northern suburbs than elsewhere. Surprisingly the impact of dense single family housing on the Hispanic share in the Route 128 Corridor approaches significance at the 5 percent level (p-value of .052). The results for any given subgroup are imprecise, but as a whole they are suggestive that the estimates from the main regressions apply not only to areas close to the city center, but to whiter and more affluent suburban areas as well.

Table 1.6: Heterogeneity of Effects of Zoning Categories on Racial Shares in Boston Sub-Metro Areas

	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)
	Black Share of Block Pop.	Black Share of Block Pop.	Black Share of Block Pop.	Black Share of Block Pop.	Hisp. Share of Block Pop.	Hisp. Share of Block Pop.	Hisp. Share of Block Pop.	Hisp. Share of Block Pop.
Boston Sub-Metro Area	Urban Core	Route 128 Corridor	North Suburbs	South Suburbs	Urban Core	Route 128 Corridor	North Suburbs	South Suburbs
Multi-Family	0.0434*	0.0443	0.0317*	0.048	0.0293*	0.0428	0.0763*	0.0147
Housing Permitted	[0.0138]	[0.0345]	[0.0081]	[0.0237]	[0.0112]	[0.0257]	[0.0268]	[0.0121]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	696	105	191	326	696	105	191	326
R-squared	0.82	0.55	0.63	0.75	0.47	0.52	0.71	0.37
Blocks Included in Regression	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
	Black Share of Block Pop.	Black Share of Block Pop.	Black Share of Block Pop.	Black Share of Block Pop.	Hisp. Share of Block Pop.	Hisp. Share of Block Pop.	Hisp. Share of Block Pop.	Hisp. Share of Block Pop.
Boston Sub-Metro Area	Urban Core	Route 128 Corridor	North Suburbs	South Suburbs	Urban Core	Route 128 Corridor	North Suburbs	South Suburbs
Single-Family Low Density (lot size > 1 acre)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Single-Fam. Med. Density	0.0188	0.0008	0.0051	-0.0014	-0.0721	0.0069	0.0196	0.0107
(lots btw 3/8 and 1 acre)	[0.0328]	[0.0043]	[0.0039]	[0.0208]	[0.0642]	[0.0064]	[0.0139]	[0.0113]
Single-Family High Density	-0.0018	0.002	0.0195**	0.0141	-0.1029	0.0124	0.0685*	0.0156
(lot sizes < 3/8 acre)	[0.0322]	[0.0051]	[0.0058]	[0.0230]	[0.0712]	[0.0064]	[0.0237]	[0.0099]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	51	1037	530	361	51	1037	530	361
R-squared	0.33	0.2	0.25	0.48	0.32	0.18	0.35	0.24
Blocks Included in Regression	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders

Notes: The unit of observation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Regressions are clustered at the town level. See Appendix for Sub-Metro Area definitions.

1.5.1 Mechanisms

To better understand how land use regulation affects block racial composition, tables 1.7 and 1.8 explore the impact of zoning on the types of residential structures on the block in the Boston metro area, omitting Boston where data is not available. Though block-level census data is only informative about the total number of dwelling units and whether they are owned or rented, parcel level assessment data subdivides the residential structures into six categories: single-family, two-family, and three-family detached housing, small (4 to 8 unit) and large (9 or more unit) apartment buildings and condominiums.

Because taxes are assessed to the owners of properties, houses and apartment buildings are listed by building, whereas condos, where units are separately owned, are listed by unit. Some towns report the number of units within an apartment building, but many do not. I can impute the number of units in a building of a given type by regressing the total number of dwelling units counted in the census on counts of each of the six building types at the block level in the full block sample. Reassuringly, the coefficients for 1, 2, and 3 family houses from this regression are almost exactly 1, 2 and 3 respectively, so that building a single family house on a block corresponds to adding one dwelling unit to the block. The coefficient is roughly 5 for small apartment buildings and 30 for large apartment buildings. For condominiums the coefficient is around 0.75 indicating that there is some measurement error in that variable likely caused by different buildings having different ownership structures. This suggests caution in interpreting the condominium results. In general these imputations will lead to understated results if the size of apartment buildings within categories is correlated with the prevalence of buildings across categories, as is likely to be the case. For instance, if larger apartment buildings tend to be built on blocks where more apartment buildings are built the imputation will understate the impact of zoning regulations on the number of apartment units. Nonetheless, these regressions can be informative about the underlying trends in building type connecting zoning regulation to racial shares.

Table 1.7 shows the impact on total units and structure type of permitting multi-family housing in the sample of blocks that lie on a border between single-family and multi-family zones. I break multi-family zoning into two categories - low-density (3 to 8 units per acre) and medium to high-density (9 units per acre and above) - as the regressions in the earlier tables suggested different impacts for these two categories. Columns one and two show the impact on the overall number of dwelling units per acre and the number of rental units per acre from census data. Going from permitting single-family housing to permitting low-density multi-family housing leads to 2.8 additional dwelling units per acre, and an increase of 2.1 additional rental units per acre. Permitting high density multi-family housing increases the number of dwelling units by 7.4 units per acre and the number of rental units by 6.1 per acre.

Moving to columns 3 through 8 the sample drops as assessment data is only available for a portion of the sample. Permitting low-density multi-family housing leads to a significant negative impact of over one single-family residence per acre, and a significant positive impact of about 1 condo unit per acre. While not significant due to the limited sample size, the magnitudes of the changes in other structure types are fairly large. Almost a full unit of two-family housing is gained, and increases are also seen in the three other multi-family dwelling types. The impacts for permitting multi-family housing show up particularly strongly for large multi-family apartment units and condominium units, with small increases in three-family houses and small apartment buildings, and decreases in one and two-family housing.

Table bottom panel of Table 1.7 repeats the same regressions, but this time for different densities of single family zoning, using the single-family housing border sample. Permitting dense (less than 3/8 acre lot sizes) single-family housing leads to 1.92 additional dwelling units per acre, and 0.58 additional rental units compared to blocks with lot sizes of 1 acre or larger. Moving from lot sizes over an acre to those between 3/8 and 1 acre yields an extra 0.56 total dwelling units, but a trivial amount of new rental housing. Not surprisingly these impacts are concentrated in increases in single, and in the case of high density single-family zoning, two-family residential units.

Table 1.7: Permitted Use and Types of Housing Units Available on Border Blocks

	(1a) Dwell. Units per Acre	(2a) Rental Units per Acre	(3a) 1-Fam Units per Acre	(4a) 2-Fam Units per Acre	(5a) 3-Fam Units per Acre	(6a) Small Apt Units per Ac.	(7a) Large Apt Units per Ac.	(8a) Condo Units per Acre
Zoned for Single Family	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Zoned for Low-Density	2.8220**	2.0896**	-1.2635**	0.9064	0.3631	0.6113	0.765	1.0575*
Multi Family Housing	[0.7369]	[0.6779]	[0.2904]	[0.6218]	[0.2300]	[0.3471]	[0.5372]	[0.4646]
Zoned for M/H Dens.	7.3760**	6.0796**	-1.2992**	-0.4816	0.9226*	0.4180*	4.0228**	2.5451*
Multi Family Housing	[1.1367]	[0.6923]	[0.2776]	[0.4686]	[0.3893]	[0.1968]	[1.2898]	[1.1820]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1924	1924	848	848	848	848	848	848
R-squared	0.67	0.6	0.61	0.62	0.58	0.38	0.42	0.4
Blocks Included in Regression	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single/Multi Fam. Borders
	(1b) Dwell. Units per Acre	(2b) Rental Units per Acre	(3b) 1-Fam Units per Acre	(4b) 2-Fam Units per Acre	(5b) 3-Fam Units per Acre	(6b) Small Apt Units per Ac.	(7b) Large Apt Units per Ac.	(8b) Condo Units per Acre
Zoned for Low Dens. SF	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Zoned for Med. Density	0.5596**	0.0615	0.5782**	0.049	0.0074	0.03	0.0259	0.018
Single Family Housing	[0.1084]	[0.0662]	[0.0947]	[0.0441]	[0.0114]	[0.0312]	[0.0332]	[0.0624]
Zoned for High Density	1.9179**	0.5843**	1.1861**	0.3886**	0.0991**	0.0850*	0.1072*	0.1838
Single Family Housing	[0.2120]	[0.1290]	[0.2029]	[0.1175]	[0.0368]	[0.0328]	[0.0507]	[0.0925]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	4033	4033	2374	2374	2374	2374	2374	2374
R-squared	0.42	0.28	0.62	0.49	0.34	0.22	0.15	0.38
Blocks Included in Regression	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders	Single-Fam. Borders

Notes: The unit of observation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

Table 1.8: Impact of Building Type on Total Units by Race

	(1) Total Dwelling Units Per Acre	(2) Black Households Per Acre	(3) Hispanic Households Per Acre	(4) White Households Per Acre	(5) Total Dwelling Units Per Acre	(6) Black Households Per Acre	(7) Hispanic Households Per Acre	(8) White Households Per Acre
Region Included	Boston Metro	Boston Metro	Boston Metro	Boston Metro	Route 128	Route 128	Route 128	Route 128
Single Family	0.9459**	0.0046	0.0079	0.8624**	0.9651**	0.0101*	0.0079**	0.8687**
Houses Per Acre	[0.0226]	[0.0054]	[0.0049]	[0.0195]	[0.0373]	[0.0044]	[0.0025]	[0.0242]
Two Family	2.0583**	0.1862*	0.1649*	1.3628**	2.4225**	0.0723**	0.0748**	2.0296**
Houses Per Acre	[0.1552]	[0.0836]	[0.0708]	[0.1715]	[0.2047]	[0.0247]	[0.0239]	[0.1739]
Three Family	2.0959**	0.0933	0.6764*	1.0423	1.9579	-0.0377	0.2776	1.4717
Houses Per Acre	[0.4513]	[0.1066]	[0.2945]	[0.5308]	[1.1921]	[0.0778]	[0.1531]	[1.0596]
Small Apartment	5.5703**	0.157	0.4921	3.8017**	3.7904*	0.3206	0.6838**	2.1009
Buildings per Acre	[0.8885]	[0.1056]	[0.3336]	[0.9909]	[1.7183]	[0.2047]	[0.2464]	[1.4079]
Large Apartment	30.4185**	3.6922**	2.6512**	18.8323**	34.4371**	2.1892**	1.6105**	23.6051**
Buildings per Acre	[3.8219]	[1.2957]	[0.5916]	[3.0556]	[10.0945]	[0.8276]	[0.6084]	[7.6139]
Condominium	0.8384**	0.0149*	0.0214	0.6692**	0.6386*	0.0195*	0.0288*	0.4143*
Units Per Acre	[0.0857]	[0.0065]	[0.0113]	[0.1000]	[0.2585]	[0.0087]	[0.0133]	[0.1635]
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	3302	3345	3345	3345	1045	1045	1045	1045
R-squared	0.79	0.51	0.63	0.81	0.76	0.49	0.55	0.83
Blocks Included in Regression	All Border Blocks	All Border Blocks	All Border Blocks	All Border Blocks	All Border Blocks	All Border Blocks	All Border Blocks	All Border Blocks

Notes: The unit of observation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

To connect this back to racial shares, in table 1.8 I regress the number of units for each race on the types of housing on the block. Column 1 regresses total units on housing types including border fixed effects for all blocks on borders. The results are what would be expected, though the number of additional units from adding three-family houses looks closer to 2 in this sample, suggesting some misclassification between 2 and 3 family houses in the data. Turning to column 2, the results for blacks show that nearly all of the gains in black households that come from crossing from one side of a border to another come from the presence of large apartment buildings. This sheds light on the results from earlier tables showing that medium and high density multi-family permitting are the only regulations that have significant impacts on the share of the block population that is black.

For Hispanics in column 3 the coefficients on three-family and small apartment buildings are also sizable, though the standard error for small apartments is too large to draw firm conclusions. Nonetheless, this is consistent with the results above indicating that low-density multi-family housing has strong impacts for the Hispanic population that are not seen for blacks. Column 4 provides the numbers for non-Hispanic whites to contrast them. Additional units of all types increase the white population, not surprisingly since they make up 70 percent of the population, but the relative impacts for whites versus minorities are much stronger in the single-family and condominium categories than for apartment units.

We might again worry that these impacts of structure type on the size of minority populations are driven by only the urban portion of the sample, and that building multi-family units might have smaller impacts in more suburban locations. I rerun the same regressions in columns 5 through 8 for just the Route 128 corridor. Column 5 shows that the gains in units for each category are roughly equal, but columns 6 and 7 show somewhat smaller increases for minority groups than the ones in columns 2 and 3. Nonetheless, additional large apartment buildings increase the black population, as do additional small and large apartments for Hispanics. The impact of additional three-family houses, while still positive for Hispanics is smaller and not distinguishable from zero with the power I have in this sample. Nonetheless, these results suggest that building more multi-family housing, especially large apartment buildings, in the suburbs does increase minority populations.

Finally, I turn to data from the 1990 census to assess the impact of zoning regulations on block-level racial composition changes over this period. Because I am using a single cross-section of zoning regulations that are presumed to stay constant over the period it is not clear we should expect much change in the impact of zoning on racial residential location patterns. However, there are a few reasons to expect that there might be differences. First, it could be that even if zoning regulations were put in place years earlier, that the composition of neighborhoods adjusts slowly and that even by 1990 blocks had not reached their steady state equilibria. In this case the primary interest would be in the 2010 level estimates, and the 1990 estimates would merely serve to illustrate how slowly the process unfolds. Alternatively, it could be that as housing demand by race changes over the period that the adjustment process differs between more and less stringently zoned blocks. For instance, consider an influx of minorities to the area. It could be that less stringently zoned neighborhoods are able to rapidly expand the stock of housing to accommodate new migrants, whereas more restrictive blocks have a largely static population of longer tenured residents.

First, in Table 1.9 I examine the impact of zoning regulation on the share of the population that is black at the block level for 1990. Even though the geographic definition of blocks does not stay constant over the period I can perform the same match for 1990 blocks to land use zones as I did for 2010. Using the sample of border blocks in 1990 I attain an identical coefficient, 0.38 percentage points, for the impact of zoned units per acre on the share of the population that is black as I did in the 2010 data. Column 3 shows that, among blocks with positive black populations this represents a somewhat higher percentage increase, 25.9 percent versus 17.5 percent found in 1990.

Table 1.9: Black Share of Block Population and Zoning -- 1990 Census

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Black Share of Block Pop.	No Blacks on Block	Logged Black Share	Black Share of Block Pop.	Black Share of Block Pop.	Black Share of Block Pop.	Black Share of Block Pop.
Zoned Dwelling	0.0038*	-0.0261**					-0.0002
Units per Acre	[0.0018]	[0.0033]					[0.0008]
Logged Zoned			0.2587*				
Units per Acre			[0.1108]				
Multi-Family				0.0257**			
Housing Permitted				[0.0084]			
Multi-Family Low Density					0.0065*		
(3-8 units per acre)					[0.0032]		
Multi-Family Medium Density					0.0372**		
(9-20 units per acre)					[0.0112]		
Multi-Family High Density					0.0366		
(20+ units per acre)					[0.0230]		
Single-family Low Density (lot size > 1 acre)						(omitted)	
Single-Family Medium Density						0.0025	
(lot sizes btw 3/8 and 1 acre)						[0.0018]	
Single-Family High Density						0.0011	
(lot sizes < 3/8 acre)						[0.0028]	
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Observations	4299	4299	1271	1222	1222	2788	2788
R-squared	0.82	0.19	0.77	0.8	0.8	0.27	0.27
Blocks Included in Regression	All Borders	All Borders	Borders w/ Black Pop > 0	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single-Fam. Borders	Single-Fam. Borders

Notes: The unit of observation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

Columns 4 through 6 repeat regressions from Table 1.3 looking at the impact of multi-family and single-family zoning independently for the 1990 sample. The 2.57 percentage point impact of permitting any type of multi-family housing is similar, though slightly smaller than the 2010 coefficient, and the difference seems particularly apparent in the impact of high-density multi-family housing in column 5. The impact of different minimum lot size restrictions among single-family zones is negligible.

Repeating the same set of regressions for the Hispanic population in Table 1.10, I find that, while the differences between Tables 1.4 and 1.10 imply that the impact of the linear density measure has only grown modestly between 1990 and 2010, the impact of permitting multi-family housing has doubled over the two decades. Comparing Table 1.5 to Table 1.10, the coefficient on allowing multi-family housing jumps from 2.8 percentage points in 1990 (column 4 to 5.77 percentage points in 2010 (column 1 in Table 1.5). The coefficients for all three density classes of multi-family housing see similar growth. The impact of changing the density of single-family housing is small and insignificant in 1990, though the confidence intervals are large enough compared to the effect that little can be said about any changes in the impact over time.

Along with comparing the magnitudes of the coefficients estimated separately for the two censuses, I can estimate the impacts of density on block-level changes over the period for the sample of blocks I am able to match across censuses. Column 1 of Table 1.11 shows a regression of the 2010 log share of the block's population that is black on logged zoned units per acre and the logged 1990 black population share with border fixed effects in the border sample. A log point increase in zoned units per acre increases the black share by 0.169 log points, with a p-value of 0.053, even controlling for the logged 1990 black share. This suggests that for blocks with black populations in 1990, less restrictive land use regulation predicted somewhat quicker growth in the black share of the population going forward.

Table 1.10: Hispanic Share of Block Population and Zoning -- 1990 Census

	(1) Hispanic Share of Block Pop.	(2) No Hispanics on Block	(3) Logged Hispanic Share	(4) Hispanic Share of Block Pop.	(5) Hispanic Share of Block Pop.	(6) Hispanic Share of Block Pop.	(7) Hispanic Share of Block Pop.
Zoned Dwelling	0.0040**	-0.0245**					0.0008
Units per Acre	[0.0008]	[0.0039]					[0.0010]
Logged Zoned			0.2919**				
Units per Acre			[0.0712]				
Multi-Family				0.0280**			
Housing Permitted				[0.0064]			
Multi-Family Low Density					0.0181*		
(3-8 units per acre)					[0.0087]		
Multi-Family Medium Density					0.0257*		
(9-20 units per acre)					[0.0095]		
Multi-Family High Density					0.0414**		
(20+ units per acre)					[0.0138]		
Single-family Low Density (lot size > 1 acre)						(omitted)	
Single-Family Medium Density						-0.0018	
(lot sizes btw 3/8 and 1 acre)						[0.0036]	
Single-Family High Density						0.0015	
(lot sizes < 3/8 acre)						[0.0041]	
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES
Observations	4299	4299	1503	1222	1222	2788	2788
R-squared	0.47	0.12	0.56	0.45	0.45	0.21	0.21
Blocks Included in Regression	All Borders	All Borders	Borders w/ Hispanic Pop	Single/Multi Fam. Borders	Single/Multi Fam. Borders	Single-Fam. Borders	Single-Fam. Borders

Notes: The unit of observation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

The coefficient of 0.425 on the 1990 black share itself suggests that a 10 percent higher black share in 1990 led to a little over a 4 percent higher black share in 2010. The fact that this coefficient is not closer to 1 likely reflects two things. First, given that both sides of the border are similar along many neighborhood dimensions we would not necessarily expect the concentration of blacks on one side of the border in 1990 to be a strong predictor of the concentration of blacks 20 years later, controlling for the impact of land use regulation. Second, since the geographic block match leads to some measurement error we would expect this coefficient to be attenuated compared to the true impact. Reassuringly, running a simple regression of the logged 2010 black share on the 1990 black share without controls in the full matched block sample yields a coefficient close to one, suggesting that measurement error is not the only contributing factor.

Turning to columns 2 through 4, I find no significant impact of dummies for either permitting of multi-family housing or higher densities of single family housing. There is not enough power to distinguish what is driving the increase seen in column 1.

Looking at columns 5 through 8, the impacts of land use restrictions on the growth in the Hispanic share at the block level between 1990 and 2010 are much larger. Column 5 shows that a 10 percent increase in zoned units per acre leads to a 3.15 percent increase in the Hispanic share, conditional on the logged 1990 Hispanic share. This coefficient is actually higher than the coefficient on the logged 1990 Hispanic share itself, suggesting that there was substantial movement of the Hispanic population across blocks on the same border. This is not surprising given the substantial growth in the overall Hispanic population over the period. Even if incumbent Hispanic residents stayed relatively immobile, if new residents' location decisions are driven more by attributes of the housing stock on either side of the border than the block-level Hispanic share, then this is the pattern of coefficients we would expect.

Table 1.11: Zoned Density and Changes in Block Attributes between 1990 and 2010

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Log Black Share, 2010	Log Black Share, 2010	Log Black Share, 2010	Log Black Share, 2010	Log Hisp. Share, 2010	Log Hisp. Share, 2010	Log Hisp. Share, 2010	Log Hisp. Share, 2010	Log Units per Ac. 2010
Logged Black	0.4283**	0.3845**	0.4857**	0.4858**					
Share, 1990	[0.0757]	[0.1093]	[0.1285]	[0.1263]					
Logged Hispanic					0.2094**	0.1692	0.2841**	0.2688**	
Share, 1990					[0.0477]	[0.0919]	[0.0988]	[0.0988]	
Log Dwell. Units									0.8273**
per Acre, 1990									[0.0221]
Log Zoned Units	0.1703			0.15	0.3215**			0.3877	0.1490**
per Acre	[0.0865]			[0.2623]	[0.0858]			[0.2016]	[0.0379]
Multi-Family		0.1838				0.3113**			
Housing Permitted		[0.1255]				[0.1029]			
Single-Family Low-Density			(omitted)				(omitted)		
Single-Family			0.0195				0.2446		
Medium-Density			[0.4192]				[0.2891]		
Single-Family			0.1345				0.4085		
High-Density			[0.4435]				[0.3094]		
Border Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	963	350	338	338	1284	448	542	542	3427
R-squared	0.92	0.89	0.88	0.88	0.79	0.72	0.71	0.71	0.97
Blocks Included in Regression	Matched Borders	Matched Multi/Sing	Merged Single Fam	Merged Single Fam	Matched Borders	Matched Multi/Sing	Merged Single Fam	Merged Single Fam	Matched Borders

Notes: The unit of observation in all regressions is the block. See notes from Table 2 for block and border selection criteria. Standard Errors are clustered at the town level. * significant at 5%; ** significant at 1%

Breaking down this impact, permitting of multi-family housing has a large and significant impact, and the impacts of different density classes of single family housing are large, but too imprecisely estimated to be significant. Using the log zoned units per acre measure in the sample of single-family borders approaches significance at the 5 percent level (p-value 0.061), suggesting that zoning regulation along the entire spectrum of densities had some effect on Hispanic housing choices.

Finally, in Column 9 I test whether blocks with less stringent zoning were able to add more housing than more stringently zoned blocks across the border. Regressing the log of dwelling units per acre in 2010 on log zoned units per acre and log dwelling units per acre in 1990, I find that a 10 percent increase in allowed units per acre led to a 1.5 percent increase in dwelling units per acre over the time period. This lends some support to the hypothesis that if minority populations are growing in the area as a whole, more densely zoned blocks may be able to build new housing more quickly to attract new minority residents. Probing this hypothesis further would require individual level migration data.

1.6 Discussion

While the border design helps to reduce omitted variable bias, endogeneity may continue to be a concern. It may be that places that had small black populations to begin with were precisely the places where more restrictive zoning laws were put in place, as historians cited above have argued. Any model that looks within towns, whether using town fixed effects or the more restrictive border design, will mitigate this concern since the town is the level of government writing zoning restrictions. In addition, some models motivating zoning legislation, such as excluding those of lower incomes to avoid drain on local public finances, act at the town rather than the neighborhood level. However, the concern might remain that the residents of certain neighborhoods might lobby their local governments to preserve those neighborhoods with zoning restrictions while allowing members of other races to move into other parts of the jurisdiction that already had more minorities. However, given the narrow spatial focus here, in order to violate the assumptions of the design there would need to be some reason why, in the absence of zoning regulation, block-level racial shares would not converge towards those of directly adjacent blocks over time. Certainly when major roads, railroad lines or streams mark the border between zones there is cause for concern that such boundaries would demarcate racially segregated neighborhoods on their own. Given that I am dropping these borders from the analysis the concern is somewhat lessened.

Also reassuring is that historical zoning maps for communities in the area such as Arlington, Newton, Quincy and Sudbury show remarkable consistency over time. In Newton, though the rules governing land use within each zone has changed over time, the borders themselves are nearly identical to those that appear on a 1921 zoning map. Similarly, the boundaries of Sudbury's residential zones remain unchanged since they were originally drawn in 1955. The list of zone changes since 1976 in Quincy numbers in the hundreds, but in nearly all cases these are not changes from one residential classification to another, but rather changes in zoning for commercial and conservation purposes that are not part of this analysis. Though a more rigorous historical examination is surely a worthy endeavor, the relative stability of these regulations over long time periods in the subset of towns for which data is readily available lends credibility to the approach taken here.

Along with the strengths of the border design come a couple of caveats about the local average treatment effects estimated using this model. A long literature explores the impact of residents' racial preferences on housing market equilibria (see, for example, Schelling (1971); Cutler et al. (1999); Card et al. (2008).) If the impact of changing zoning regimes is to change the racial composition of the neighborhood, then that change may itself beget further changes in neighborhood composition through the interaction of preferences for neighbors in the housing market. Since the underlying assumption of the border fixed effects design is that neighborhood attributes stay constant across the zoning border, this effect, by assumption, should be equal on either side and will therefore be absorbed by the border fixed effects. In light of this, the estimates here are best seen as lower bounds for the overall impact that changes in zoning regulations will have over time. What is being isolated here is the variation that acts through the mechanisms discussed earlier; that is, through changing housing types and proportion of home ownership, price changes that result directly from zoning and the stasis effect of slowing down new construction. Incorporating the spillover effect to the neighborhood could be achieved by adding more structure to the model such as is done in Bayer et al. (2007) and Kasy (2012), but doing so requires individual level data that is unavailable here. Alternatively, one could return to a larger unit of geography such as the metro area where the unit of observation is sufficiently large as to rule out spillovers beyond its bounds, though at the risk of inviting back in the confounding factors discussed in the review of prior literature.

Furthermore, as with any local average treatment effect, caution should be taken in extrapolating these results to other contexts. Boston in particular has some of the strictest land use regulations in the country as measured both by Pendall (2000) and the Wharton Residential Land Use Survey, and it would be interesting to see how the micro-level estimates compare in regions with a less extreme distribution of zoning. Another unique feature in Massachusetts is Regulation 40B, a statewide statute that allows developers to seek state authorization to override local zoning authority in communities where less than 10 percent of housing is deemed affordable in exchange for maintaining at least 20 percent of the new units as affordable (Fisher, 2008). The threat of this law has also motivated some municipalities to enact their own inclusionary zoning laws to achieve the same outcomes with more local control. However, according to an examination of these policies by Schuetz et al. (2009) these laws have led to only modest levels of production of affordable housing, with only about a fifth of communities reporting any new housing built under their inclusionary zoning laws. If communities made widespread use of these regulations the evidence I find from zoning borders might be attenuated compared to what would be found in places without such regulations, but Schuetz's work suggests that perhaps the lost revenue from having to set aside affordable units mutes the impact of these laws.

Even within Massachusetts, the estimates are only informative about places that look like those that fall along zoning borders. Allowing construction of multi-family apartment buildings may have quite different effects if enacted in a rural area zoned entirely for an agricultural and residential mix than it would in places that border currently extant multi-family zones. The heterogeneity analysis showing strong impacts even in suburban areas such as the Route 128 Corridor is reassuring here, but that may mask variability within that region between places close to and far away from multi-family districts. Fortunately, the margins likely to be relevant for policy are precisely those along which the impacts are being identified in the data as communities are most likely to enact small policy changes by moving one or two lot size categories or from higher density single family to permitting of multi-family housing.

Proceeding with caution given these caveats, I conclude the analysis by seeing what my results imply about the impact of zoning on area level segregation measures. One way of assessing this is to take my estimates of the impact of zoning on block level log population growth by race and simulate the impact of equalizing zoning regulation across the area. This should not be thought of as a policy simulation, since nobody is suggesting that the areas towards the city center are going to substantially reduce zoning density to meet the suburbs at the halfway point. Rather this is an attempt to estimate segregation in the absence of zoning variation while keeping the area's overall minority populations constant.

I measure metro area level segregation using the dissimilarity index at the tract level. For two racial groups, the dissimilarity index measures the percentage of one group that would have to move in order for that group's tract-level share of the population to be equal across the area. This is a common measure in the sociology and economics literature on segregation, and is the measure used by Rothwell and Massey (2009) in their papers on the impact of zoning regulation.

Table 1.12 shows the dissimilarity index for blacks and non-blacks across the largest 88 metropolitan areas with populations over 600,000 in the 2010 census as calculated by Glaeser and Vigdor (2012). Boston ranks 27th with a dissimilarity index of 57.6, while Springfield is 35th at 55.7 and Worcester is 55th at 47.3. Because my data only includes the Massachusetts portion of the Boston metro area I measure a slightly smaller value of 56.4 for Boston's dissimilarity index. I also use the updated 2013 redefinition of the Springfield metro area which removes the largely rural Franklin County and modestly lowers the dissimilarity index to 54.5. Neither of these changes affects the relative ranking of the cities by more than 1 place on the list.

Table 1.12: Segregation Across US Metro Areas, 2010

Rank	Metropolitan Area	Dissimilarity	Population
1	Milwaukee-Waukesha-West Allis, WI	0.777	1,555,908
2	Detroit-Warren-Dearborn, MI	0.735	4,296,250
3	Chicago-Naperville-Elgin, IL-IN-WI	0.719	9,461,105
4	Cleveland-Elyria, OH	0.715	2,077,240
5	St. Louis, MO-IL	0.71	2,787,701
6	Buffalo-Cheektowaga-Niagara Falls, NY	0.699	1,135,509
7	Cincinnati, OH-KY-IN	0.68	2,114,580
8	Dayton, OH	0.656	799,232
9	Pittsburgh, PA	0.649	2,356,285
10	New York-Newark-Jersey City, NY-NJ-PA	0.647	19,567,410
11	Syracuse, NY	0.646	662,577
12	Birmingham-Hoover, AL	0.643	1,128,047
13	Toledo, OH	0.63	610,001
13	Indianapolis-Carmel-Anderson, IN	0.63	1,887,877
15	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	0.626	5,965,343
16	Baltimore-Columbia-Towson, MD	0.622	2,710,489
17	Rochester, NY	0.616	1,079,671
18	Columbus, OH	0.603	1,901,974
19	New Orleans-Metairie, LA	0.597	1,189,866
20	Memphis, TN-MS-AR	0.591	1,324,829
20	Grand Rapids-Wyoming, MI	0.591	988,938
22	Omaha-Council Bluffs, NE-IA	0.588	865,350
23	Albany-Schenectady-Troy, NY	0.585	870,716
24	Akron, OH	0.583	703,200
25	Miami-Fort Lauderdale-West Palm Beach, FL	0.581	5,564,635
26	Kansas City, MO-KS	0.577	2,009,342
27	**Boston-Cambridge-Newton, MA-NH**	**0.576**	**4,552,402**
28	Denver-Aurora-Lakewood, CO	0.567	2,543,482
29	Hartford-West Hartford-East Hartford, CT	0.563	1,212,381
30	Louisville/Jefferson County, KY-IN	0.562	1,235,708
30	Bridgeport-Stamford-Norwalk, CT	0.562	916,829
32	Washington-Arlington-Alexandria, DC-VA-MD-WV	0.561	5,636,232
33	Little Rock-North Little Rock-Conway, AR	0.56	699,757
34	Baton Rouge, LA	0.559	802,484
35	**Springfield, MA**	**0.557**	**621,570**
36	Cape Coral-Fort Myers, FL	0.545	618,754
36	Los Angeles-Long Beach-Anaheim, CA	0.545	12,828,837
38	New Haven-Milford, CT	0.544	862,477
39	Atlanta-Sandy Springs-Roswell, GA	0.541	5,286,728
40	Knoxville, TN	0.529	837,571
41	Wichita, KS	0.528	630,919
42	Nashville-Davidson--Murfreesboro--Franklin, TN	0.525	1,670,890
43	Tulsa, OK	0.517	937,478
44	Winston-Salem, NC	0.512	640,595

Notes: Data are from Edward Glaeser and Jacob Vigdor's "The End of the Segregated Century: Racial Separation in America's Neighborhoods, 1890-2010." Mannhattan Institute Civic Report, January 2012.

Table 1.12: Segregation Across US Metro Areas, 2010 (continued)

Rank	Metropolitan Area	Dissimilarity	Population
45	San Francisco-Oakland-Hayward, CA	0.505	4,335,391
46	Jacksonville, FL	0.504	1,345,596
46	Tampa-St. Petersburg-Clearwater, FL	0.504	2,783,243
48	North Port-Sarasota-Bradenton, FL	0.503	702,281
49	Greensboro-High Point, NC	0.498	723,801
50	Richmond, VA	0.496	1,208,101
51	Oklahoma City, OK	0.487	1,252,987
52	Minneapolis-St. Paul-Bloomington, MN-WI	0.48	3,348,859
53	Houston-The Woodlands-Sugar Land, TX	0.478	5,920,416
54	Dallas-Fort Worth-Arlington, TX	0.475	6,426,214
55	**Worcester, MA-CT**	**0.473**	**916,980**
56	Providence-Warwick, RI-MA	0.472	1,600,852
57	Charlotte-Concord-Gastonia, NC-SC	0.471	2,217,012
58	Columbia, SC	0.464	767,598
59	Madison, WI	0.461	605,435
60	Honolulu, HI	0.451	953,207
61	Virginia Beach-Norfolk-Newport News, VA-NC	0.449	1,676,822
62	Sacramento--Roseville--Arden-Arcade, CA	0.445	2,149,127
63	Orlando-Kissimmee-Sanford, FL	0.435	2,134,411
64	Seattle-Tacoma-Bellevue, WA	0.43	3,439,809
65	Portland-Vancouver-Hillsboro, OR-WA	0.423	2,226,009
66	San Antonio-New Braunfels, TX	0.421	2,142,508
67	Allentown-Bethlehem-Easton, PA-NJ	0.418	821,173
68	Greenville-Anderson-Mauldin, SC	0.415	824,112
69	Bakersfield, CA	0.401	839,631
70	Lakeland-Winter Haven, FL	0.397	602,095
71	Fresno, CA	0.391	930,450
72	Charleston-North Charleston, SC	0.39	664,607
73	Raleigh, NC	0.386	1,130,490
73	San Diego-Carlsbad, CA	0.386	3,095,313
75	El Paso, TX	0.385	804,123
76	Austin-Round Rock, TX	0.382	1,716,289
77	McAllen-Edinburg-Mission, TX	0.341	774,769
78	Colorado Springs, CO	0.34	645,613
79	Riverside-San Bernardino-Ontario, CA	0.326	4,224,851
80	Salt Lake City, UT	0.322	1,087,873
81	Stockton-Lodi, CA	0.314	685,306
82	Phoenix-Mesa-Scottsdale, AZ	0.312	4,192,887
83	Tucson, AZ	0.293	980,263
84	Boise City, ID	0.284	616,561
85	Las Vegas-Henderson-Paradise, NV	0.281	1,951,269
86	San Jose-Sunnyvale-Santa Clara, CA	0.253	1,836,911
87	Oxnard-Thousand Oaks-Ventura, CA	0.244	823,318
88	Albuquerque, NM	0.243	887,077

Notes: Data are from Edward Glaeser and Jacob Vigdor's “The End of the Segregated Century: Racial Separation in America’s Neighborhoods, 1890-2010.” Mannhattan Institute Civic Report, January 2012.

To simulate the removal of zoning regulation I calculate the average zoned units per acre at the metro and tract level using the block level data. The average densities for the Springfield, Worcester and Boston areas are 4.63, 5.03 and 7.22 respectively, roughly the average number of units observed for dense single family housing. Using my coefficient from the first column of Table 1.2, I multiply the difference between the tract average and the metro area average by .0038 percentage points and add that to the original black population. This results in a dissimilarity index for Boston of 49.9, with Springfield only modestly affected at 52.7 and Worcester plummeting to 32.9, which would be among the lowest values observed in the data. The change for Boston is substantial; the simulated value would take Boston from being the 27th ranked to the 48th ranked metro area in dissimilarity. Its neighbors in that region of the table, Dallas, Houston and Oklahoma City, are among the least regulated metro areas in the country according to the average Wharton Residential Land Use Regulation Index, whereas Boston is ranked second. The simulation suggests that as much as three quarters of the Boston to Houston gap could be accounted for by land use regulation alone. On the other hand, the estimate is much smaller than that of Rothwell and Massey, whose results suggested that moving from the most to least restrictive zoning regime could have an impact on the dissimilarity index as large as 0.23 points.

1.7 Conclusion

Do strict density regulations have an exclusionary impact on minority populations in stringently zoned neighborhoods? The results I present here for Massachusetts suggest that they do. For each additional unit allowed per acre, the black share of the population increases by 0.38 percentage points and the Hispanic share increases by 0.5 percentage points. The impact of permitting multi-family housing is particularly strong, with the black share increasing by 3.38 percentage points and the Hispanic share by 5.77 percentage points. By estimating the impacts using only areas along zoning borders I am able to control for potentially omitted town and neighborhood effects, isolating the variation coming from moving from a block on one side of a zoning boundary to another. This paper is the first in this literature to isolate such narrow spatial variation.

Future work is necessary to confirm the validity of these results in contexts beyond Massachusetts, and to disentangle the mechanisms driving the results. Of particular interest is the intersection between race and socioeconomic status. While block level census data are available by race, no income measures are available making it difficult to separate income from the other channels by which land use regulation might influence racial location. Given that much of the impact is mediated through changes in the types of structures built, and that the proportion of minorities owning homes lags whites even within income categories, it is unlikely the entire result can be explained by income alone. Nonetheless, income surely plays a substantial role. Even aside from any racial interaction, the effect of zoning on segregation by income and educational attainment are worthy of study in their own right.

While changes in the dissimilarity index tend not to fit themselves neatly into canonical social welfare functions, these results may be of interest to policymakers who see lower (or higher) levels of racial segregation as a desirable outcome. The Department of Housing and Urban Development issued new guidelines in July 2013 with the goal of "Affirmatively Furthering Fair Housing" and has threatened to withhold block grant money from New York's Westchester County, among others, due to "restrictive practices" such as limits on density and building types it sees as racially and ethnically exclusionary. Angered by what he sees as federal overreach, a Westchester County Executive penned a Wall Street Journal Op-Ed (Astorino, 2013) asking residents whether they "think it is a good idea to give the Department of Housing and Urban Development unchecked authority to put an apartment building in your neighborhood." While the results here cannot tell us about the desirability of such a federal policy, they do imply that it would likely result in a substantial decrease in racial segregation.

Chapter 2

The Complementarity Between Cities and Skills[1]

2.1 Introduction

The connection between area size and per worker productivity and income is a core fact at the center of urban economics (Glaeser, 2008). The connection between urban density and earnings is understood to be a primary reason that cities exist. Understanding the connection between city size and productivity is a core task for students of agglomeration.

This paper notes that the connection between city size and productivity does not hold for less skilled metropolitan areas in the United States today. In the least well-educated third of metropolitan areas, there is virtually no connection between city size and productivity or income. In the most well-educated third of metropolitan areas, area population can explain 45 percent of the variation in per-worker productivity.

Why does productivity increase with area population for skilled places, but not for unskilled places? One hypothesis is that the connection between productivity and area size reflects a tendency of more skilled people to locate in big cities. However, even in the more skilled places, controlling for area-level skills can only explain a quarter of the measured agglomeration effect. If unobserved skills were explaining the correlation, then we would expect real wages to rise with

[1]Co-authored with Edward L. Glaeser.

city population, which they do, but that effect seems to explain only 30 percent of the connection between city size and income or productivity.

We divide the theories of agglomeration into two broad categories: those that emphasize the spread of knowledge in cities and those that do not. Among the latter group is the view that cities are more productive because of advantages unrelated to agglomeration, such as access to ports or harbors or good government, and the possibility that capital is more abundant in big cities. Nonknowledge-based theories also include standard agglomeration models, where urban proximity reduces transport costs. In Section 2.3, we address these theories. While there is little evidence that directly supports these hypotheses, there is little evidence with which to reject them either. In Section 2.4, we turn to two core knowledge-based theories of urban agglomeration, which can both readily explain why the productivity-city size connection is so much stronger in higher human capital metropolitan areas.

The first hypothesis, which comes from Marshall (1890)'s statement that in agglomerations the "mysteries of the trade" are "in the air," is that density makes it easier for workers to learn from each other. The second hypothesis is that high levels of human capital and city size interact to push out the frontier of knowledge and the level of productivity. While these two hypotheses predict similar things about the links between productivity, human capital and city size, two natural versions of the theories have different implications for wage growth in skilled cities. The learning interpretation suggests that age-earnings profiles should be steeper in big, skilled areas, because workers are learning more rapidly. One version of the innovation interpretation implies that age-earnings profiles in such places are flatter, because technological change is proceeding rapidly and making the skills of older people obsolete. This implication requires the added assumption that technological change causes some skills to become out of date.

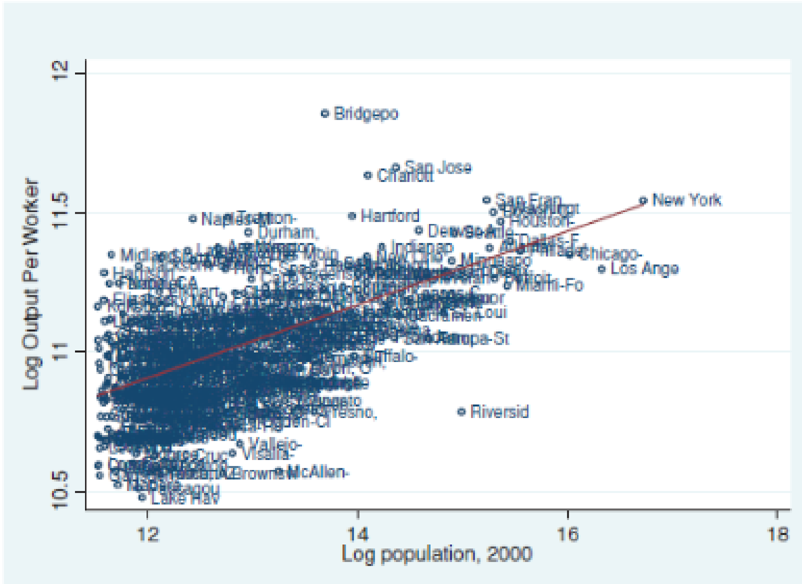
As in Glaeser and Mare (2001), we find some evidence supporting the view that workers learn more quickly in metropolitan areas. We also find that this learning effect is stronger in more skilled areas. However, we do not find that age-earnings profiles are steeper in bigger metropolitan areas, and the interaction between area size, area skills, and experience is insignificant. While these findings are quite compatible with the view that cities and skills are complements, they do not clearly indicate whether this complementarity works through learning, innovation, both or neither.

The natural implication of the view that cities and human capital are complements is that cities will become more, not less, important if humanity continues acquiring knowledge. The importance of connecting in dense urban areas will only increase if knowledge becomes more important, at least as long as technological shifts do not eliminate the urban edge in transferring information.

2.2 The Interaction Between Skills And City Population

We begin with metropolitan area-level correlations between size, skills, and productivity since Gross Metropolitan Product numbers are available at the area, but not the individual, level. We then turn to individual-level regressions that use income data and individual controls. Figure 2.1 illustrates the well-known connection between city size and productivity per worker. In this figure, productivity per worker is calculated as the ratio of Gross Metropolitan Product in 2001 (as calculated by the Bureau of Economic Analysis) to the total labor force. The raw elasticity is 0.13, meaning that as population increases by 100 percent, productivity rises by nine percent. Of course, one part of this connection is that bigger metropolitan areas do seem to have more skilled workers, as shown in Figure 2.2. The tendency of more skilled people to live in metropolitan areas might reflect a greater demand of more skilled people for urban amenities, or perhaps that cities disproportionately increase the productivity of more skilled workers. These two theories can be distinguished; if this connection reflected a demand for amenities it would mean that cities are skilled because of abundant labor supply, and we should expect to see lower wages for skilled workers in big cities (Glaeser, 2008). A naive attempt to control for the share of adults with college degrees at the metropolitan area level yields the following regression

$$Log(OutputPerWorker) = 9.49 + 0.098 * Log(Population) + 1.18 * PctBA \tag{2.1}$$



Notes: (i) Units of observation are Metropolitan Statistical Areas (MSAs) under the 2006 definitions with populations above 100,000. Labor force and population is from the Census, as described in the Appendix. Gross Metropolitan Product is from the Bureau of Economic Analysis.
(ii) The regression line is *Log GMP per capita* = 0.13 [0.01] * *Log population* + 9.3 [0.12]. $R^2 = 0.36$ and $N = 335$.

Figure 2.1: Output per Worker and Area Size

Notes: (i) Units of observation are MSAs under the 2006 definitions with populations above 100,000. Statistics are from the Census.
(ii) The regression line is *Share with BAs* = 0.028 [0.003] * *Log population* −0.13 [0.044]. $R^2 = 0.16$ and $N = 335$.

Figure 2.2: Area Skill and Area Size

Output per worker continues to be gross metropolitan product divided by the size of the labor force. The R^2 is 0.47 and there are 335 observations. The coefficient on log of population declines slightly, from 0.13 to 0.098, roughly a 25 percent decline. Just controlling for human capital eliminates about one-quarter of the connection between area population and output per worker.

But it appears that the effects of human capital and city size are not independent. When we interact the two variables, we estimate

$$Log(OutputPerWorker) = 0.08 * Log(Pop) + 1.26 * PctBA + 0.51 * Log(Pop) * PctBA \quad (2.2)$$

The final refers to the product of log of area population (demeaned) and share with college degrees (also demeaned). An intercept was included in the estimation but is not reported for space reasons. The R^2 is now 0.49. The demeaning of the variables means that both raw coefficients can be interpreted as the impact of the variable, when the other variable has taken on its mean level. The interaction means that when the share with college degrees is at its minimum observed value of 0.09 (which would be .0.13 relative to the mean), the estimated coefficient on population is just 0.01, whereas for the maximum value of 0.52, the estimated effect is 0.23. If we instead run this regression with the logarithm of per capita income, we estimate coefficients of 0.026 on the log of population, 1.43 on share of the population with college degrees and 0.42 on the interaction. In this income specification, the t-statistic on the interaction is 4.5. If we use log of median family income as the dependent variable, the estimated coefficients are 0.019, 1.55 and 0.36 on the three variables. The t-statistic on the interaction remains over 4. Our independent variables are certainly endogenous, and we have no perfect source of exogenous variation that solves this problem. However, similar results appear if we use variables from 1940 (population, share with college degrees, and the interaction) instead of contemporaneous variables to explain current gross metropolitan product. In that case, we estimate

$$Log(OutputPerWorker) = 0.07 * Log(Pop) + 5.04 * PctBA + 2.47 * Log(Pop) * PctBA \quad (2.3)$$

In this case, there are 334 observations and the R^2 is 0.34. The high coefficient on the lagged share of the population with college degrees reflects, in part, the tendency of skilled places to become more skilled over time, as discussed in Berry and Glaeser (2005).

In individual-level regressions, which control for individual-level human capital and experience, our results weaken significantly. The first regression of Table 2.1 shows the 0.041 coefficient when individual yearly log earnings are regressed on metropolitan area size (also found in Glaeser and Gottlieb (2008). This coefficient is less than one-half of the baseline coefficient estimated in the aggregate gross metropolitan product regression. Controlling for the share of the population with college degrees pushes the coefficient down further to 0.028. In the third regression, we show that the interaction between population and the share with college degrees is positive, although significant only at the 10 percent level.

The individual-level results are qualitatively similar to those above although weaker in magnitude. The differences between the individual and aggregate regressions reflect primarily the fact that the aggregate results are weakest for the largest metropolitan areas, which are weighted heavily in these individual-level regressions. The regression in column 4 repeats the regression in 3 weighting by the inverse of Metropolitan Statistical Area (MSA) population (so smaller metropolitan areas get more weight). In this case, the results look similar to the aggregate results.

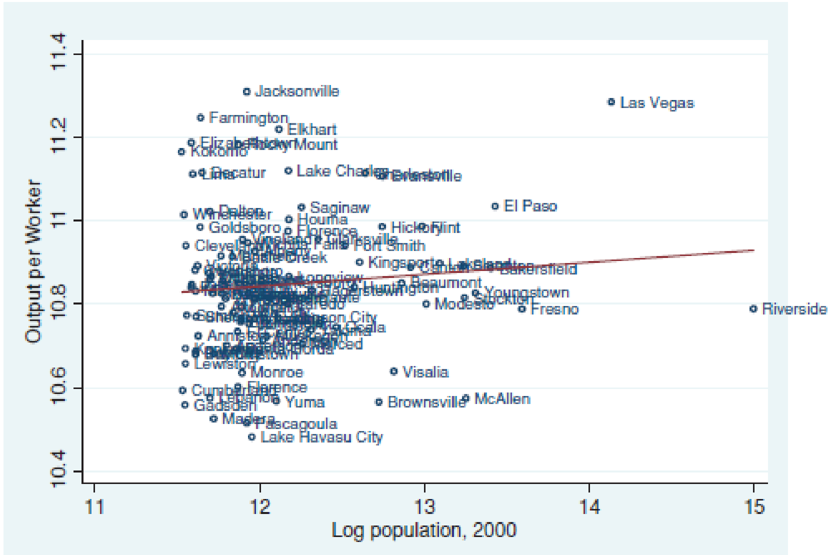
Figures 2.3 and 2.4 show the interaction between output per worker and metropolitan area population graphically. Figure 2.3 shows this relationship in the 100 least well-educated metropolitan areas with populations over 100,000. Figure 2.4 shows the relationship between metropolitan area population and output per worker in the 100 most well-educated areas with populations over 100,000. Among less well-educated places, there is essentially no agglomeration effect. In the most well-educated places, population can explain 45 percent of the variation in productivity. In these well-educated places, including further controls for education has virtually no effect on the city size effect, so the measured coefficient of 0.13 is the same with or without controlling for human capital. The same basic pattern appears with different measures of earnings, such as per capita income or median family income. In high human capital cities, the agglomeration effect is strong. In low human capital cities, it is weak or nonexistent.[2]

[2]Interestingly, there is significant cross effect between city human capital and city size in the population growth context.While highly skilled cities grow more swiftly than less skilled areas (Glaeser and Saiz, 2004; Shapiro, 2006), this effect is not larger in bigger areas.

Table 2.1: Log Annual Income on City Population and Education Levels interacted with Individual Experience and Education Levels

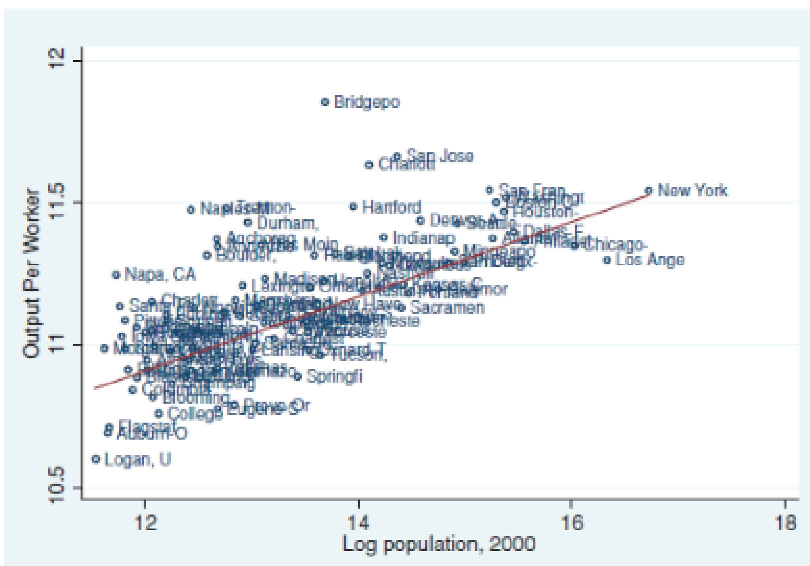
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Log of Annual Income						
MSA-Level Covariates:							
Log of MSA	0.041	0.028	0.022	0.038	0.034	0.044	0.021
Population	[0.011]***	[0.011]**	[0.012]*	[0.006]***	[0.016]**	[0.019]**	[0.018]
Share of MSA Adults		0.639	0.411	0.208	0.415	-0.11	-0.895
with a BA		[0.144]***	[0.122]***	[0.086]**	[0.123]***	[0.318]	[0.287]***
Log Pop * BA Share			0.196	0.413	0.193	0.193	0.885
			[0.113]*	[0.087]***	[0.113]*	[0.113]*	[0.229]***
Individual-MSA Interactions:							
Log Exp * Log MSA Pop					-0.004	-0.007	0
					[0.004]	[0.005]	[0.004]
Log Exp * MSA BA Share						0.18	0.448
						[0.095]*	[0.086]***
Log Exp* Log MSA Pop*							-0.236
MSA BA Share							[0.057]***
Individual-Level Covariates:							
Log Experience	0.25	0.252	0.252	0.251	0.258	0.256	0.254
	[0.004]***	[0.004]***	[0.004]***	[0.005]***	[0.006]***	[0.005]***	[0.005]***
Education Dummies:							
0-9 years	-0.59	-0.587	-0.586	-0.584	-0.586	-0.585	-0.585
	[0.010]***	[0.009]***	[0.009]***	[0.011]***	[0.009]***	[0.009]***	[0.009]***
10-11 years	-0.33	-0.327	-0.327	-0.319	-0.327	-0.327	-0.326
	[0.005]***	[0.005]***	[0.006]***	[0.006]***	[0.006]***	[0.006]***	[0.006]***
13-15 years	0.207	0.204	0.204	0.179	0.204	0.204	0.204
	[0.004]***	[0.004]***	[0.004]***	[0.004]***	[0.004]***	[0.004]***	[0.004]***
16 years	0.575	0.565	0.566	0.516	0.566	0.566	0.566
	[0.008]***	[0.008]***	[0.008]***	[0.006]***	[0.008]***	[0.008]***	[0.008]***
17+ years	0.788	0.774	0.774	0.717	0.774	0.774	0.775
	[0.011]***	[0.010]***	[0.010]***	[0.008]***	[0.010]***	[0.010]***	[0.010]***
Constant	9.409	9.406	9.406	9.41	9.388	9.394	9.401
	[0.015]***	[0.015]***	[0.015]***	[0.018]***	[0.019]***	[0.018]***	[0.017]***
Weighted	NO	NO	NO	YES	YES	YES	YES
Observations	2102175	2102175	2102175	2102175	2102175	2102175	2102175
R-Squared	0.16	0.17	0.17	0.15	0.17	0.17	0.17

Notes: All variables derived from US Census, with the individual level data accessed through the IPUMS. Weights are inverse population weights, such that the each MSA gets equal weight. Standard errors are clustered at the MSA level. * significant at 10%; ** significant at 5%, *** significant at 1%



Notes: (i) Units of observation are MSAs under the 2006 definitions with populations above 100,000 and where the share of adults with college degrees is less than 17.65 percent. Labor force and population is from the Census, as described in the Appendix. Gross Metropolitan Product is from the Bureau of Economic Analysis.
(ii) The regression line is *Log GMP per capita* = 0.028 [0.028] * *Log population* + 10.50 [0.34].
$R^2 = 0.01$ and $N = 100$.

Figure 2.3: Productivity and Area Size in Less Skilled MSAs



Notes: (i) Units of observation are MSAs under the 2006 definitions with populations above 100,000 and where the share of adults with college degrees is greater than 25.025 percent. Labor force and population is from the Census, as described in the Appendix. Gross Metropolitan Product is from the Bureau of Economic Analysis.
(ii) The regression line is *Log GMP per capita* = 0.128 [0.015] * *Log population* + 9.46 [0.19].
$R^2 = 0.44$ and $N = 100$.

Figure 2.4: Productivity and Area Size in More Skilled MSAs

One hypothesis is that the connection between cities and productivity represents omitted skills that are either obtained before working or learned on the job. It could certainly be possible that the connection between city size and productivity is higher in skilled cities because the correlation between skills and population is particularly strong in such places.[3] We will address the theory that cities enhance skill acquisition later. Here, we just discuss the possibility that the urban wage premium reflects preexisting skills. After all, as Bacalod et al. (2010) emphasize, skills are far more than years of education. Glaeser and Mare (2001) do a fair amount of work showing that the urban wage premium (as opposed to the more continuous correlation between city size and productivity or earnings) survives a large number of measures of individual human capital, such as test scores and instrumental variables approaches that use parental state of birth characteristics.

One of their pieces of evidence supporting the view that omitted pre-market human capital variables are not higher in cities is that real wages, that is, wages controlling for local price levels, do not rise significantly in urban areas. If people in cities had higher levels of innate human capital, then they should be earning higher real wages as well as higher nominal wages. After all, they are more skilled. Of course, estimated real wages would need to be adjusted for local amenities, and amenities may be either higher or lower in large urban areas.[4] Glaeser and Mare (2001) find little connection between city size and real wages in their sample of cities. In our considerably larger sample, we also find little connection between the log of median family income, divided by the American Chamber of Commerce Research Association local price index, and city population, at least once we control for the share of the population with college degrees.

However, this result is not true in the more skilled cities where agglomeration elasticities are strongest. For example, if we look only at those areas where the share of population with college degrees is greater than 25.025 percent (the same cutoff used to establish the top 100 skilled cities above), we find that

[3]If skills were learned in big cities, then more human capital in big cities would lead to more learning in the model of Glaeser (1999). If skills were preexisting, then it would be possible that omitted aspects of human capital were more important at the high end of the skill distribution which is overrepresented in skilled places.

[4]Glaeser (2008), Chapter 3, presents a lengthy discussion of the spatial equilibrium, RosenRoback model, which underlies this logic.

$$Log(RealFamilyIncome) = 9.07 + 0.025 * Log(Population) + 1.00 * PctBA \tag{2.4}$$

There are 100 observations and the R^2 is 0.27. All data come from the Census except for the price indices used to turn nominal into real income, which come from the American Chamber of Commerce Research Association.[5]

Real incomes rise significantly with skills, which is compatible with the view that more skilled people are more productive. While real incomes do not rise with city size, across the entire population, in these skilled areas, there is a positive connection. This connection can be interpreted as either implying that there is a greater level of unobserved human capital in these areas or that these bigger cities are particularly unpleasant and higher wages are compensation for negative amenities. However, controlling for some obvious amenities, such as temperature, does little to change this result, and we have trouble believing that there are more negative amenities in big skilled cities than in big unskilled cities.[6]

If the coefficient on city size is treated as a measure of the extent to which unobserved skills rise with city size in this skilled city subsample, this would mean that about 30 percent of the urban productivity coefficient could be explained by human capital (0.025/0.08).[7]. Since observed human capital is uncorrelated with city size in this subsample, this is a plausible measure of the extent to which human capital explains the city size effect in these cities. In the larger sample that includes skilled and unskilled cities, bigger cities do have higher observed levels of human capital, and controlling for skills can explain about one-quarter of the connection between city size and productivity, but there is little sign that unobserved human capital is higher in bigger metropolitan areas in that larger sample of cities. In either case, human capital appears to explain at most 30 percent of the city size effect, leaving at least 70 percent to be explained.[8]

[5] A better procedure would be to use individual-level data and individual-level price controls as in Moretti (2013).

[6] For example, the problem of urban crime is particularly prevalent in less skilled metropolitan areas.

[7] Note that this real-wage method would only get at exogenous unobserved skills. If cities created unobserved skills endogenously, then in a spatial equilibrium, workers should end up paying for those skills with higher costs of living (Glaeser and Mare, 2001)

[8] Combes et al. (2008) find that unobserved skills can explain up to one half of the connection between agglomeration size and wages in France. The discrepancy between their results and our results here might reflect differences between the United States and France or their use of individual fixed effects to control for unobserved

Understanding why the city size effect is larger in skilled places seems particularly pressing.

2.3 Urban Productivity Framework

We now use a standard production function to consider alternative interpretations of our agglomeration results.[9] In a standard production function, output per worker can be written as $PAF(K, hL)/L$, where P is the price of the good, A is the level of productivity, K is the level of capital, and hL reflects the amount of effective labor, with h as human capital and L as the number of workers. If the production function is homogenous of degree one, which is necessary for a zero-profit equilibrium, then output per worker can be rewritten as $PAF(k, h)$, where k reflects physical capital per worker and h reflects human capital. If the production function is Cobb-Douglas, with parameter β on labor, then differentiating this quantity with respect to any exogenous variable Z, such as city population, yields the following decomposition:

$$\frac{\partial OutputPerWorker}{\partial Log(Z)} = \frac{\partial Log(P)}{\partial Log(Z)} + \frac{\partial Log(A)}{\partial Log(Z)} + (1-\beta)\frac{\partial Log(k)}{\partial Log(Z)} + \beta\frac{\partial Log(h)}{\partial Log(Z)} \tag{2.5}$$

Wages per worker equal the wage per effective unit of human capital times the amount of human capital per worker. In a standard Cobb-Douglas formulation, wages per worker equal β times output per worker.

To close the model, capital and labor should also be endogenized. If workers are to be indifferent across locations, which is a necessary condition for the existence of a spatial equilibrium (Glaeser, 2008), then high costs of living must offset high wages. But that fact does not change the fact that high wages must also be offset by something making firms more productive, and our focus is on this latter relationship.

The connection between output per worker and city size could represent an increase in prices, productivity, capital per worker, or human capital per worker, in big cities. The relative importance of the different forces will surely differ across industries. Barbers will have a higher output per worker in bigger cities, but much of that difference will reflect higher prices, not capital per worker, or even human capital. Conversely, the prices of traded manufactured goods

skills.

[9] Puga (2010) provides a more thorough discussion of the different sources of agglomeration economies.

are more or less constant over space, and any variation in output per worker in that industry is likely to reflect productivity or capital, either physical or human.

We will divide up these theories into two sets of hypotheses. One set of theories emphasizes greater knowledge in cities, which could mean higher levels of h or a higher level of A brought on by the urban exchange of ideas.We will address that set of theories in the next section. The other set of theories focuses on other causes of urban productivity, which include innate urban advantages, such as access to waterways or good government, higher levels of capital per worker, and non-knowledge-based agglomeration economies.

Conceptually, it would be quite possible for the strong connection between city size and productivity to reflect omitted characteristics of a location that both enhance productivity and attract workers. In the 19th century, it seems undebatable that the waterways of New York and Chicago made these places economically successful and attracted people to them (Glaeser, 2005). Yet few urbanists believe that locational advantages have much direct impact on productivity today.[10] Cities long ago gave up on those industries that were tied to their local geography. Today, cities are more likely to specialize in business services (Kolko and Neumark, 2008), and it is hard to see how those services get an edge from a harbor or a coal mine. Natural advantages seem to explain only 25 percent of the concentration of manufacturing industries (Ellison and Glaeser, 1999).

We are less sure that natural advantage is irrelevant in explaining the connection between city size and productivity, but it seems unlikely that any natural advantages can explain why that connection is stronger in more skilled cities. After all, many of these natural advantages would seem to have their largest impact on less skilled industries. Indeed, that is exactly what a cursory examination of the data reveals. Variables like proximity to the great lakes or harbors positively impact productivity in less skilled places, but have no impact in more skilled areas. For example, the correlation between per capita income and miles from the nearest body of water is 0.33 for less educated cities and 0.03 for more educated cities. If this result holds more generally, and innate advantage matters more for less skilled workers, then the fact that city

[10] Combes et al. (2010) use historical sources of innate advantage as instruments for current population density, which requires that these variables be orthogonal to current productivity.

size increases productivity more for places with more skills is evidence against the importance of such natural advantages.

One way in which natural advantage might matter today is that past historical natural advantages might have led to more investment in physical capital. Typically, physical capital is treated as endogenous and for that reason, not really a plausible determinant of agglomeration economies. For example, in the model sketched above, if purchased by producers at a cost r, which might differ across space, then a Cobb-Douglas relationship would imply that:

$$\frac{\partial OutputPerWorker}{\partial Log(Z)} = \frac{1}{\beta}\left(\frac{\partial Log(P)}{\partial Log(Z)} + \frac{\partial Log(A)}{\partial Log(Z)}\right) - \frac{(1-\beta)}{\beta}\frac{\partial Log(r)}{\partial Log(Z)} + \frac{\partial Log(h)}{\partial Log(Z)} \tag{2.6}$$

If physical capital is endogenously determined, then it can only increase the connection between city size and output per worker if capital is cheaper in big, dense cities. Typically, evidence on real estate costs would suggest that capital is, if anything more expensive in big cities, which reflects the greater scarcity of land.

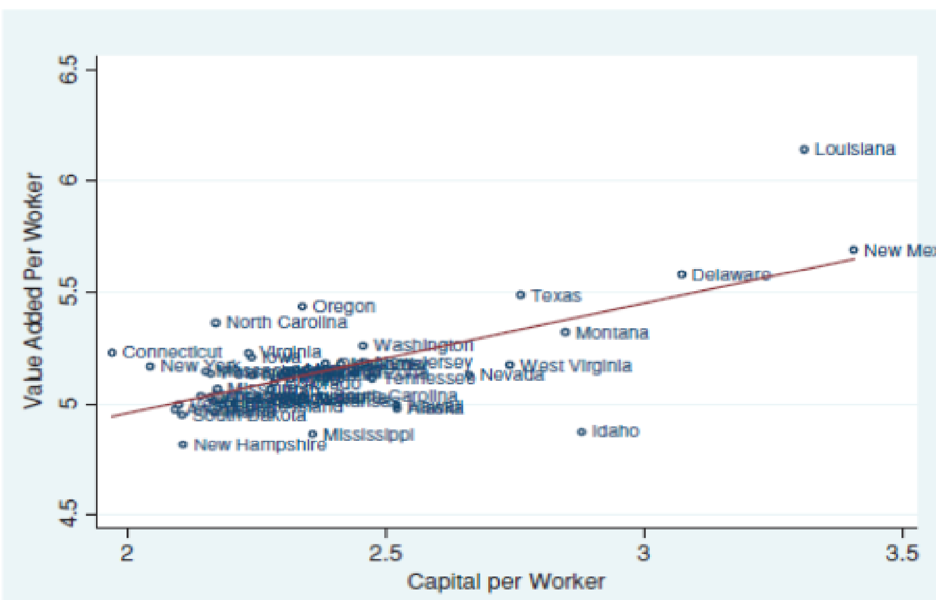
However, if big cities have long invested in durable physical capital, then that capital might remain and might increase productivity today. Certainly, casual observation of cities such as New York, London, and Paris suggests that they have advantages that come from centuries of public and private investment in physical capital. Is there any evidence to support this view? Unfortunately, there is little good measurement of physical capital at the metropolitan area level. A few heroic social scientists, such as Munnell (1991) and Garofalo and Yamarik (2002) have created state-level estimates of the capital stock, but these estimates have been based on apportioning the national capital stock to states on the basis of the types of industries in those states.[11] At the state level, for manufacturing industries, the Census of Manufacturers provides an estimate of expenditures on capital. These numbers are problematic in two ways: they represent an estimate of the flow of investment not the stock of capital and they address only manufacturing.

[11] A similar procedure could be used at the metropolitan area level, but we doubt that it would be seen as particularly compelling to suggest that New York Citys capital stock is the same as the nation, except for its mix of major industries.

Table 2.2: State-Level Density and Output

	(1)	(2)	(3)	(4)	(5)	(6)
	Log Value Added			Log Wage		
State-Level Density	0.585	0.787	0.559	0.458	0.551	0.342
	[0.304]	[0.314]	[0.337]	[0.178]	[0.188]	[0.192]
Log Capital Per Worker		0.244			0.112	
		[0.132]			[.0789]	
Years of Schooling			0.0177			0.0775
			[0.0911]			[.0518]
Constant	4.339	3.516	4.137	2.297	1.919	1.416
	[0.397]	[0.588]	[1.111]	[0.233]	[0.351]	[0.632]
Observations	37	37	37	37	37	37
R-Squared	0.096	0.178	0.097	0.158	0.205	0.21

Notes: State-level density and years of schooling from Ciconne and Hall (1996). Log value added, log wage and log capital per worker from 2006 Annual Survey of Manufacturers. Robust standard errors in parentheses.



Notes: (i) Measures of value added and capital per worker are taken from the Census of Manufacturers as described in the Appendix.
(ii) The regression line is *Log Value Added per Worker* = 0. 4924 [0.079] * *Log Capital per Worker* + 3.97 [0.191].
$R^2 = 0.45$ and $N = 49$.

Figure 2.5: Value Added Per Worker and Physical Capital

While there is certainly a robust relationship between capital expenditures and value added per worker, shown in Figure 2.5, controlling for capital expenditures only increases the relationship between state-level density and value added per worker or income. Table 2.2 shows the relationship between the Ciccone and Hall (1996) index of state-level density and two measures of output: value added per worker and hourly wage for production workers for states with more than 50,000 manufacturing workers. Columns 2 and 4 show the increased connection between output and density when a control for capital expenditures is added. The raw correlation between capital expenditures and density is negative. These results should not lead us to think that the capital stock explanation for urban productivity is disproved, but rather that this sliver of available evidence does not support that hypothesis. In columns 3 and 6, we include controls for years of schooling taken, for comparability reasons, also from Ciccone and Hall (1996). Schooling has a tiny and insignificant impact on value added per worker, and a larger but still insignificant effect on the hourly wage. Controlling for schooling reduces the coefficient on density in the wage regression, but not the value-added regression, because education seems to influence wages more than value added.

Still, this evidence only informs us about current expenditures, not the stock of accumulated urban capital. We know of no good measures of such historical investment, but we can at least ask whether historical development eliminates either the current link between population and productivity or the interaction between that variable and the share of the population with college degrees. Including the logarithm of population in 1900 as a control in regression 2.2 yields

$$\begin{aligned} Log(OutputPerWorker) = 0.72 * Log(Pop_{2000}) + 1.23 * PctBA + 0.53 \\ * Log(Pop_{2000}) * PctBA + 0.15 * Log(Pop_{1900}) \end{aligned} \tag{2.7}$$

There are many problems with this regression, including the fact that population growth between 1900 and today is hardly random, but its results give little hope to the view that historical investment in capital stock explains either the basic agglomeration effect or the interaction between education and population. Neither coefficient is substantially changed from Equation 2.2. We have also experimented using geographic instruments, like proximity to the Great Lakes or rivers navigable in 1900, which do predict population in that year, but instrumental variables regressions show little change relative to the ordinary least squares regressions. As such, we find little evidence to support the view that greater capital in cities explains much.[12] Equations (2.5) and (2.6) leave us with two alternative views about the connection between productivity and area size. In principle, the equations suggest that either higher prices or standard agglomeration effects, coming from reductions in transport costs, could explain the productivity-area size link. We believe that these two views can be taken together, since in many cases, higher prices are directly reflecting agglomeration economies. For example in Krugman (1991), concentrated firms are able to get more for their goods because other firms are located in the same area. Prices will actually be lower in the core as well, because transport costs are saved, and lower costs of intermediate goods can also increase productivity.

There is a long and distinguished literature on agglomeration economies, and there is little doubt that many forms of such economies exist. Such traditional agglomeration effects are compatible with the absence of agglomeration economies in low human capital cities only if there is some reason why the industries in those cities do not benefit from proximity, while industries in high-human capital cities do. Yet controlling for the industrial characteristics of the metropolitan area, and for interactions between these variables and area population, has little impact on the robust interaction between population and skill levels. It is not clear if all of these theories can explain the interaction between city size and human capital, but at least some of them can. For example, if agglomeration economies came from the reduction of transaction costs in business services, and if those costs took the form of lost time, then the value of reducing these time costs would be higher in place with higher levels of human capital. If these standard agglomeration economies explain the city size-productivity link, then hopefully future work will help us to understand why these effects are stronger in more educated places.

2.4 The Link Between Human Capital And Agglomeration Economies

While standard agglomeration theories do not automatically predict the interaction between urban size and area education, theories that emphasize the spread of knowledge in urban areas

[12] These estimates primarily focus on private capital. Many forms of public capital, such as roads, are disproportionately present in less dense areas (Duranton and Turner, 2012), so we suspect that controlling for public capital would do little to explain the connection between density and productivity.

do. If cities facilitate the spread of information, then this advantage will be more important when the people living in those cities have higher levels of human capital. This suggests that there are two, in some senses quite similar, hypotheses that can explain the overall connection between productivity and agglomeration and why the agglomeration effects are so much stronger in skilled places. One view is that workers acquire more skills in big, skilled areas (Glaeser, 1999; Peri, 2002). The second view is that the Solow residual is higher in such places because of the speedy spread of ideas. According to the first of these theories, the workers on Wall Street benefit from the ability to learn more quickly from each other. According to the second view, their firms' leaders are better able to acquire ideas in these areas.

While this latter hypothesis has been taken seriously since Lucas (1988), we know of little direct evidence testing this view.[13] There has been more work on the connection between worker human capital accumulation and urban density. The two views differ in their predictions about the age-earnings profile in cities. The worker-learning hypothesis suggests that age-earnings profiles should be steeper in skilled, dense areas where workers learn from each other. The innovation hypothesis can mean that skills depreciate more quickly in such places, which would make the age-earnings profile flatter. We test to distinguish these two hypotheses here.

2.4.1 Evidence on Worker Learning in Cities

Glaeser and Mare (2001) examine the urban wage premium in models with worker-fixed effects. They find that only a modest fraction of the urban wage premium is earned by workers when they come to urban areas. Similarly, the urban wage premium is not lost by workers when they leave big cities. Instead, workers who came to cities experience somewhat faster wage growth. This evidence seems to point against a generalized urban-productivity effect toward a wage-growth effect, which could be interpreted as faster learning in cities. This wage growth may also be associated with easier job hopping in cities, where workers increase wages and productivity as they move from firm to firm (Freedman, 2008). The connection between wage gains and job mobility may reflect better matching in cities, or the gradual accumulation of human capital

[13] Relatively little work has been done using microdata to assess whether firm productivity rises with time in a dense, or well-educated city. Breau and Rigby (2008) look at such a learning model, but focus on learning through exporting.

that is acquired when individuals work for different employers.

Since human capital accumulation is typically inferred by looking at age-earnings profiles, it is particularly natural to test the hypothesis that cities increase the rate of human capital accumulation by looking at whether wage growth is faster over the life-cycle in metropolitan areas. Table 2.3 shows the basic pattern of wage growth in urban areas. The dependent variable is the log of hourly wage, and data come from the 2000 Census. The first column shows the basic pattern of wage growth over the life-cycle for males between the ages of 25 and 65 (to avoid retirement issues and working part time). Experience is defined as age minus years of education minus six.

The first column shows that the majority of earnings growth occurs over the first 15 years. Relative to workers with between 0 and 5 years of experience, workers with between 6 and 10 years of experience earn 0.194 log points higher wages and workers with between 11 and 15 years of experience gain 0.335 log points in wages. Wage growth continues, albeit at a slower clip, throughout ones life.

In the second column, we show the interactions of years of the independent variables with residing in a metropolitan area. We do not report the overall experience coefficients to save space, though they remain similar to those shown in the first column. The coefficients in the second column reflect the extra gains in wages that seem to accrue to metropolitan workers at each experience level. Metropolitan area workers earn a level effect of 0.036 log points more than nonmetro workers at the start of their careers. This gap rises an additional 0.028 log points for workers with between 6 and 10 years of experience.Workers with between 11 and 15 years of experience earn 0.06 log points on top of the level effect, meaning a total premium of 0.096 log points. The coefficients then level off.

These results that replicate those found in Glaeser and Mare (2001) for the 2000 Census, suggest that human capital accumulation is faster in metropolitan areas. The metropolitan area wage effect for inexperienced workers is about one-third its value for more experienced workers. This finding hints at the possibility that much of the effect of cities comes over time, as workers either acquire skills more quickly, or perhaps match more efficiently in large places.

Table 2.3: Log Hourly Wage on the Interactions of Metro Residence and Human Capital Varibles

	(1) Basic Human Capital Regression	(2) Metro Areas vs. Non-Metro	(3) Highly Educated Metro Area vs. Non-Metro	(4) Low Educated Metro Area vs. Non-Metro	Col 3 & 4 differ at 1% level	(5) Highly Populated vs. Less Populated MSAs	(6) High Pop vs. Less Pop: Highly Educated MSAs
In Metro Area		0.034 [0.007]***					
In High Educ MSA			0.069 [0.007]***		yes		
In Low Educ MSA				0.015 [0.011]			
In High Pop MSA						0.081 [0.006]***	0.088 [0.008]***
Experience Dummies:			(0-5 years is omitted category)				
6-10 years	0.194 [0.003]***	0.028 [0.007]***	0.035 [0.007]***	0.004 [0.012]	yes	0.002 [0.006]	-0.005 [0.008]
11-15 years	0.335 [0.003]***	0.06 [0.007]***	0.075 [0.007]***	0.017 [0.012]	yes	0.006 [0.006]	-0.009 [0.008]
16-20 years	0.423 [0.003]***	0.074 [0.007]***	0.093 [0.007]***	0.027 [0.012]**	yes	0.01 [0.006]*	-0.014 [0.008]*
21-25 years	0.466 [0.003]***	0.074 [0.007]***	0.089 [0.007]***	0.044 [0.012]***	yes	0.007 [0.006]	-0.009 [0.008]
26-30 years	0.493 [0.003]***	0.067 [0.007]***	0.077 [0.007]***	0.043 [0.012]***	yes	0 [0.006]	-0.014 [0.008]*
31-35 years	0.523 [0.003]***	0.075 [0.007]***	0.084 [0.008]***	0.053 [0.012]***	yes	-0.001 [0.006]	-0.019 [0.008]**
36-40 years	0.535 [0.003]***	0.067 [0.008]***	0.076 [0.008]***	0.046 [0.013]***	no	-0.001 [0.007]	-0.013 [0.009]
41+ years	0.515 [0.003]***	0.079 [0.008]***	0.09 [0.009]***	0.051 [0.013]***	yes	0 [0.007]	0 [0.010]
Education Dummies:			(12 years is omitted category)				
0-9 years	-0.297 [0.002]***	-0.047 [0.005]***	-0.055 [0.005]***	-0.06 [0.007]***	no	-0.036 [0.005]***	-0.026 [0.007]***
10-11 years	-0.152 [0.002]***	-0.007 [0.004]*	-0.006 [0.004]	-0.015 [0.006]**	no	-0.011 [0.004]**	-0.02 [0.006]***
13-15 years	0.108 [0.001]***	0.025 [0.003]***	0.021 [0.003]***	0.026 [0.004]***	no	0.015 [0.003]***	0.01 [0.004]***
16 years	0.304 [0.002]***	0.093 [0.004]***	0.093 [0.004]***	0.032 [0.007]***	yes	0.015 [0.003]***	0.004 [0.005]
17+ years	0.407 [0.002]***	0.099 [0.006]***	0.095 [0.006]***	0.062 [0.010]***	yes	0.016 [0.005]***	0.008 [0.006]
Nonwhite	-0.117 [0.001]***	-0.011 [0.003]***	-0.03 [0.003]***	0.018 [0.005]***	yes	-0.038 [0.002]***	-0.068 [0.003]***
Pct in Occup. with BA	0.508 [0.002]***	0.095 [0.005]***	0.103 [0.006]***	0.007 [0.009]	yes	0.03 [0.005]***	0.011 [0.007]
Observations	2914329	2914329	1928911	1071431		2102498	1117080
R-squared	0.19	0.19	0.21	0.13		0.2	0.21

Notes: Coefficients on experience and education in columns 2 through 6 are the interactions of those variables and the metro-level variable that applies to that column. The uninteracted education and experience variables are also included in the regression, but their coefficients are not reported due to space constraints. Standard errors are clustered at the MSA level. * significant at 10%; ** significant at 5%, *** significant at 1%

While there is a significant interaction between metropolitan area status and experience, there is no clear link between metropolitan area population and log of experience. In column 5 of Table 2.1, we report the absence of such a connection. Workers in a metropolitan area face a steeper age-earnings profile, but the wage profile does not become particularly steep in larger metropolitan areas. In regression 6 of Table 2.1, we show that being in a skilled area does steepen the age-earnings profile, which is compatible with the view that people are learning more in skilled areas. Regression 7 shows that there is no interaction between metropolitan area population and share with college degrees, which perhaps is unsurprising because there was no experience effect of metropolitan area population.

Returning to Table 2.3, where there is a basic metropolitan area effect, we now look to see whether there is an interaction between that effect and the skill level of the metropolitan area. Column 3 shows the comparison between those in the 100 most skilled MSAs and those living outside metropolitan areas. Working in these areas provides a large-level effect of 0.069 log points to workers immediately upon starting employment. The experience profile is steeper in these skilled cities than in the full sample shown in column 2. Workers with 6 to 10 years of experience earn an additional 0.035 log point premium, and this rises to 0.075 for those with 11 to 15 years and 0.093 log points for those with 16 to 20 years. These results mean that experience is associated with a 0.162 log point premium for workers in skilled metropolitan areas relative to nonmetropolitan workers.

Column 4 shows that the same does not hold in the 100 least skilled MSAs. Here the level effect is small and insignificant, and the experience trajectory substantially flatter, showing no significant difference with the nonmetropolitan workers until the 16 to 20 year group. The wage growth associated with living in a metro area comes primarily from highly skilled cities. The F-tests in columns 3 and 4 show that the differences in coefficients are significant at the one percent level.

As in our results in Table 2.1, the fifth and sixth columns find less support for an interaction between city size and experience. Column 5 compares those living in the 25 most populated metropolitan areas to those living in all other metro areas, and finds a significant level effect of 0.081 log points, but no effect on the experience profile. The presence of an interaction between city size and city skill would imply that we might see a stronger effect if we limit the sample to only those in highly skilled cities, but this turns out not to be the case, as Column 6 shows a similar level effect, and no effect on the experience-earnings path.

The results in Table 2.3 also cast doubt on the view that skilled people are drawn by amenities to locate in larger or more skilled metropolitan areas. If that hypothesis were correct, then the presence of skilled people would act as something of a labor supply shock and we should expect lower earnings for more skilled people in large agglomerations. If amenities were higher in big cities for skilled workers, then the logic of a spatial equilibrium suggests that wages should be lower. Yet across all of our specifications, the interactions between skills and metropolitan locations are positive. As such, it does not seem likely that amenities are causing more skilled people to locate in large metropolitan areas.

More direct evidence on knowledge fails to provide much support to the learning-in-cities hypothesis. In Table 2.4, we look at the connection between tests of reasoning and vocabulary and both being raised in and currently residing in a city. This evidence is from the General Social Survey (GSS) that subjects adults to tests and has a question about the place in which the adult was brought up. Using place of childhood residence is presumably slightly more exogenous than using place of current residence, but we use both.

The first two columns show that while rural children do worse, the highest test scores were earned by people who were brought up in suburbs. People brought up in big cities do slightly worse on these tests than people brought up in small towns. In the second two columns, we look at place of current residence and find little evidence of a connection between city residence and these skills. While these tests will not capture the most important skills learned working in a big metropolitan area, the fact that we do not find any significant link is not supportive of the learning-in-cities hypothesis.

These results are meant primarily to illustrate the type of evidence that could definitively show that people in cities learn more quickly. So far, no such evidence exists. It is true that people in cities enjoy faster wage growth, but that wage growth is concentrated in more skilled areas. There is no direct evidence linking measurable skill accumulation to urban residence.

Table 2.4: Vocabulary and Reasoning by Places of Residence

	(1) Number Correct on Vocab Test	(2) Number Correct on Reasoning Test	(3) Number Correct on Vocab Test	(4) Number Correct on Reasoning Test
Residence at Age 16:				
Rural, Non-Farm	-0.2605	-0.323		
	[0.0463]**	[0.1278]*		
Rural, Farm	-0.4229	-0.2659		
	[0.0414]**	[0.1168]*		
Small Town (under 50,000)	(omitted)	(omitted)		
Small City	0.0235	-0.1101		
(50,000 - 250,000)	[0.0419]	[0.1046]		
Suburb of Large City	0.2833	0.081		
	[0.0458]**	[0.1084]		
Large City (250,000+)	-0.0748	-0.2612		
	[0.0433]	[0.1164]*		
Current Residence:				
Rural			-0.1079	0.002
			[0.0481]*	[0.1519]
Small Town (under 50,000)			(omitted)	(omitted)
Suburb of Small City			0.112	0.1772
			[0.0464]*	[0.1311]
Small City			-0.1336	0.3092
(50,000 - 250,000)			[0.0509]**	[0.1355]*
Suburb of Large City			0.1964	0.0114
			[0.0443]**	[0.1247]
Large City (250,000+)			-0.094	0.1467
			[0.0497]	[0.1392]
Years of Schooling	0.3485	0.1962	0.3591	0.2029
	[0.0049]**	[0.0128]**	[0.0048]**	[0.0128]**
Age	0.0541	0.024	0.0498	0.0233
	[0.0045]**	[0.0132]	[0.0045]**	[0.0133]
Age Squared	-0.0004	-0.0003	-0.0003	-0.0003
Observations	[0.0000]**	[0.0001]*	[0.0000]**	[0.0001]*
Male Dummy	-0.1906	0.0229	-0.2065	0.0173
	[0.0269]**	[0.0707]	[0.0269]**	[0.0707]
Observations	22929	2182	22970	2185
R-Squared	0.27	0.15	0.27	0.14

Notes: Data presented come from the General Social Survey. See the Data Appendix for more details. Robust standard errors in parentheses. significant at 10%; ** significant at 5%, *** significant at 1%

2.5 Conclusion

In this paper, we document that agglomeration effects are much stronger for cities with more skills. This finding points to agglomeration theories that emphasize knowledge accumulation in big cities, rather than theories that emphasize natural advantage or gains from speedy movement of basic commodities. Yet, there is little direct evidence on the knowledge-based agglomeration economies. Empirical researchers have not managed as of yet, to sort out how these agglomeration economies work.

Glaeser and Mare (2001) put forward some evidence suggesting that skill accumulation works faster in metropolitan areas. We duplicate that evidence here, and find that these learning effects are strongest in more skilled metropolitan areas. While these results suggest a strong complementarity between skills, city size, and learning, other direct tests of that complementarity find little evidence. At present we are left with tantalizing hints, but little that is conclusive.

One speculative interpretation of the results is that two things are simultaneously happening in skilled, big cities. First, workers are indeed learning from one another more quickly. Second, the rate of technological change is faster. Together, both effects create the interaction between city size and population across skilled metropolitan areas. The results on age-earnings profiles would be ambiguous if both effects were present, because sometimes the learning effect (which steepens the profile) dominates and sometimes the technological change effect (which flattens the profile) dominates. We hope that further research will sort out these interpretations.

Chapter 3

Regionalism Versus Fragmentation: An Assessment of the Impact of the Structure of Local Governance from 1970 to 2010

3.1 Introduction

Are local governments prepared to face the challenges of the 21st century? An increasingly loud chorus of researchers and politicians argue that they are not.[1] Local governments, in their view, are too fractionalized to continue to maintain and provide the necessary infrastructure for a population increasingly concentrated in large metro areas. They lack sufficient coordination to make key regional planning decisions, and instead battle with each other to exclude new development, relegating building to the urban fringe, pushing up rents and limiting population growth. They encourage the formation of homogeneous enclaves with little racial or economic diversity, segregating minority and low income residents in less desirable portions of the city. Regional governance, in this view, is the way of the future if only sufficiently powerful coalitions

[1] For a sampling of such voices, see the essays compiled by Bruce **?** in the collection "Reflections on Regionalism."

can be formed to make it happen.

In large swaths of the country, particularly in the South and West, regionalism is already present, and has been for some time. Metro areas in Arizona and New Mexico average just one municipal or town government for every 1600 square miles of land area, compared to one for every 16 square miles in Pennsylvania and New Jersey metro areas, and the number of such governments has remained almost constant over at least a 50 year period. This considerable cross-MSA variation provides an opportunity to examine the impacts of government fragmentation over the past several decades to better understand the role that it plays in shaping urban outcomes. Is pessimism about the impacts of urban fractionalization warranted, or, as been argued by some economists dating back to Charles Tiebout, does a plethora of smaller jurisdictions encourage competition and more efficient provision of public goods by local governments?

Disentangling the answers to these questions in the data is made difficult by the high degree of correlation between the level of fractionalization and other historical urban attributes. Areas with highly fractionalized governments tend to be places near the east coast or the Great Lakes, where settlement occurred early and manufacturing was thriving for much of the 20th century. By contrast, regionalized government is more common in Sun Belt locations that entered the latter half of the century with sparser populations and warm winter temperatures that proved attractive once air conditioning lessened the disamenity of hot summers.

While part of the optimism of regionalists comes from the rapid expansion of these areas, the positive impacts of regionalism on population and income growth are mostly washed away by a relatively small set of controls that takes account of these differences in starting position. While pinning down precise zeros is tough, especially with such strong correlation between variables, the results presented here do nothing to strengthen the argument for regionalism's impact on population and income growth, though they suggest little downside either.

Where impacts are more apparent are on variables more closely tied to the sorting of different types of people across and within metro areas. The share of educated workers seems to be growing more quickly in places with highly fractionalized governments, even when controlling for a host of regional confounders. While there is some evidence that people born in these places are more likely to become college graduates, perhaps lending support to the role of Tiebout sorting in education production, the preference of mobile educated adults for living in these areas is more likely a reflection of amenities in production or consumption that are particularly appealing to the more educated, rather than a desire to stay in place after completing schooling.

The strongest downside to fragmentation that comes through clearly in the data is the strong positive impact on segregation. Even as segregation of blacks and non-blacks has fallen sharply across the entire country, fractionalized places have lagged slightly behind their more regionalized peers in realizing this decline. What in 1970 was a modest relationship between fractionalization and segregation that disappeared upon conditioning on the size of the black and overall populations, has grown to be a robust difference by 2010. Despite this, fractionalized locations have not lost their appeal to black residents; if anything their black populations have grown more quickly. Finally I examine the impact of fragmentation on sprawl and find mixed evidence. In neither levels nor changes is there much difference in the residential density gradient between fractionalized and regionalized areas in 1970 and 2010. However, employment does appear to be less centralized in fragmented metro in areas in the 2010 cross-section. Unfortunately the time series for employment location does not stretch back far enough to allow for a meaningful comparison across time, so whether this is a result of initial conditions or subsequent sprawl remains unclear.

Following this introduction I chart the historical evolution of local government fragmentation and look at its correlates in early data. I then consider in more depth Tiebout's theory of the benefits of competition and under what conditions regional cooperation would be more advantageous. The bulk of the paper is devoted to examining these hypotheses using data from 1970 through 2010 on urban growth, education levels, segregation and sprawl.

3.2 The Origins of Local Government Fragmentation

Figure 3.1 shows the nearly perfect correlation between the log of the number of municipal and town governments per 100 square miles in US metro areas from the 1962 Census of Governments and the same variable from 2007.

Figure 3.1: Local Governments in 1962 and 2007

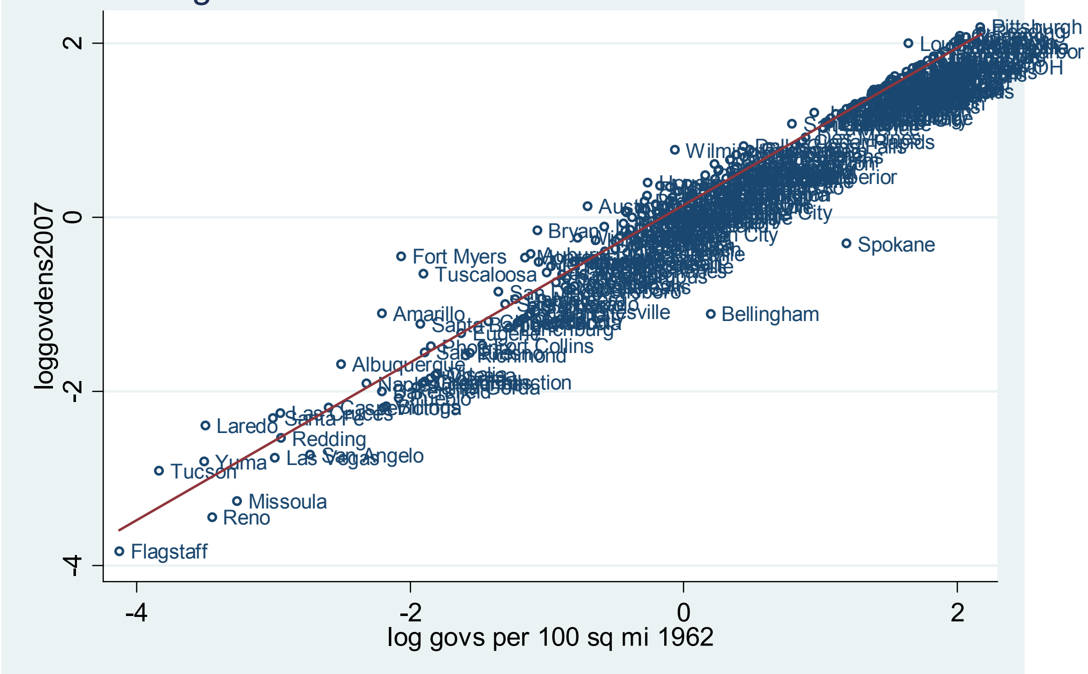
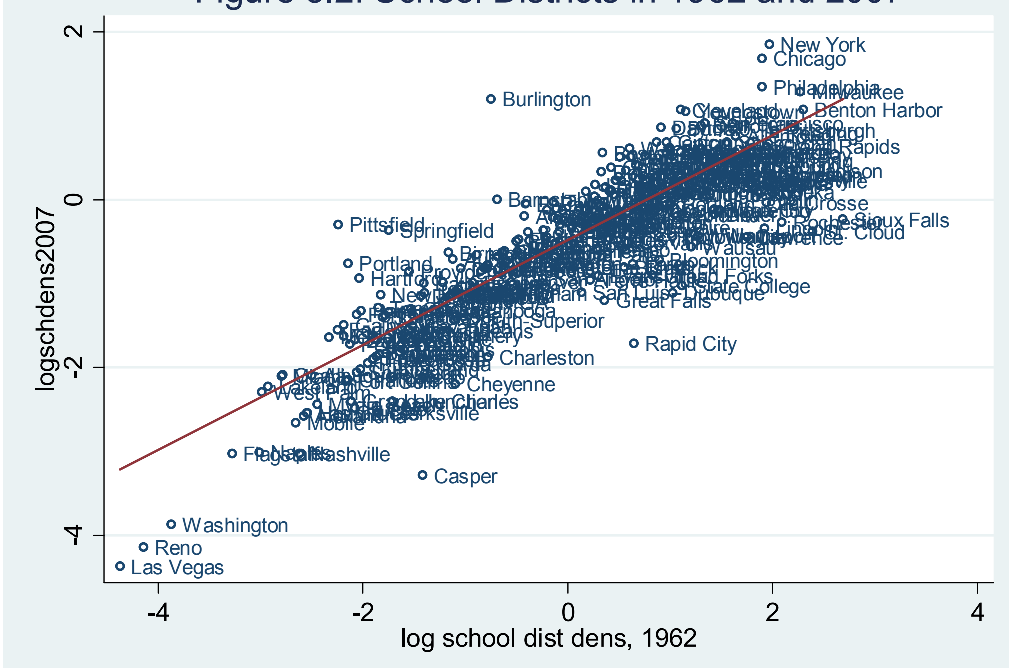


Figure 3.2: School Districts in 1962 and 2007



The correlation coefficient is 0.978 and the coefficient from a regression is very close to one; with few exceptions the number of local governments has remained unchanged for nearly a half century. Stability, however, has not always been the case when it comes to local governance. While counts of governments for all metro areas are not available for prior years, historical accounts suggest a very different pattern in earlier time periods.

The Boston area provides one example. While Massachusetts, and New England more broadly, have long prided themselves on participatory local governance centered on small town meetings, this tradition did little to slow the aggressive annexation of surrounding towns by Boston throughout the latter part of the 19th century. Boston annexed the town of Roxbury in 1868, followed by Dorchester in 1870, and Charlestown, Brighton and West Roxbury in 1874, though it was famously rebuked by Brookline voters in a referendum the preceding year. The city would resume expansion in 1912 with the annexation of Hyde Park, but has not added land area since.

Boston's history in this regard is not atypical. While New York's consolidation of surrounding towns into a five-borough metropolis is the most famous example of surrounding cities being absorbed into a central government, cities throughout the densely settled portion of the country routinely expanded their geographic scope by annexation and consolidation throughout the latter part of the 19th century. In fact, Brookline's rejection of Boston's overture was the first notable example of a wealthy suburban enclave resisting the push for consolidation with a larger central city, an example soon to have many followers as suburbs grew in the wake of continuing transportation advances around the turn of the century (Jackson, 1985). By the early to mid 20th century few suburbs saw any advantage to merging with central cities that contained larger poor, minority and immigrant populations, and the current map of municipal and town governance was more or less fixed.

That is not to say there has been no change in the boundaries of local governments over the past century, but rather that the flux has been concentrated in places with large unincorporated areas, and amongst school districts and special districts that often bridge town boundaries, or carve out space within them. Cities whose populations have expanded more recently in the South and West have often found it easy to add land area as their development has expanded into outlying unincorporated areas. This freedom is not available in the Northeast and much of the Midwest where nearly all land is already incorporated (Rusk, 2003). In these regions, the slowdown in consolidations and annexations was followed by the proliferation of many small independent school districts that did not always align with town boundaries, as well as a host of special districts for water, sewerage, fire and later on, housing and urban renewal. These more ad hoc forms of government likely reduced the demand for subsequent waves of governmental consolidation, allowing regional functions to be performed without fully regionalizing the government, but nonetheless left most local decision-making power in the hands of municipal and town governments.

Figures 3.2 and 3.3 show the changes between 1962 and 2007 in the number of school districts and special districts. The correlation over time is strong, 0.86 for school districts and 0.76 for special districts, though not as perfect as that seen for metropolitan and town governments. Furthermore, the aggregate changes are striking - the number of independent school districts was cut in half over the time period, while the number of special districts doubled. In light of the more transitory nature of these forms of governance, I will be focusing on the more permanent town and municipal governments as my main variable of interest in the results for the paper, examining the impact of the 1962 level on subsequent changes in urban outcomes. Reassuringly, the three forms of governance are highly correlated, for instance, Figure 3.4 shows the correlation of 0.62 between the number of school districts in 1962 and the number of town and municipal governments in the same year.

Before turning to an examination of the consequences of government fragmentation, I look first at the historical correlates of local government density. Given the way that government consolidations played out over time, we might expect to see strong correlations between the density of local governments in an area and variables that correlate with the time of settlement of that area. Table 3.1 confirms that indeed, many variables such as year of statehood, area temperature, historical population and concentration of manufacturing have strong correlations with the log of the number of local governments per 100 miles. Figures 3.5 through 3.12 present these correlations visually.

Table 3.1: The Correlates of Local Government Fractionalization

	Log Gov Dens	Statehood	Jan Temp	July Temp	Mfg 1970	Mfg 1900	Pop 1900	Pop 1970	BA Share	Fam Inc	Rent
Log of Local Gov Density, 1962	1										
Year of Statehood	-0.4349	1									
Mean January Temperature	-0.5618	0.0156	1								
Mean July Temperature	-0.3462	-0.0155	0.644	1							
Manufacturing Share, 1900	0.5384	-0.4113	-0.3779	-0.3716	1						
Manufacturing Share, 1970	0.619	-0.5561	-0.3769	-0.2737	0.6094	1					
Log of Population, 1900	0.5834	-0.4764	-0.3055	-0.1933	0.5961	0.522	1				
Log of Population, 1970	0.3157	-0.2185	0.0478	-0.036	0.4408	0.2461	0.73	1			
Pct of Adults with a BA, 1970	-0.1355	0.2605	-0.0403	-0.1337	-0.2282	-0.4463	-0.1421	-0.0213	1		
Log Mean Family Income, 1970	0.4052	0.0204	-0.5023	-0.5025	0.4694	0.3117	0.3941	0.4967	0.2811	1	
Log of Mean Rent, 1970	0.1948	0.1458	-0.2765	-0.3838	0.1704	-0.0635	0.1467	0.3633	0.5495	0.759	1

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Temperature data is from 1994 City and County Data Books. The remaining data comes from the US Census.

Figure 3.3: Special Districts in 1962 and 2007

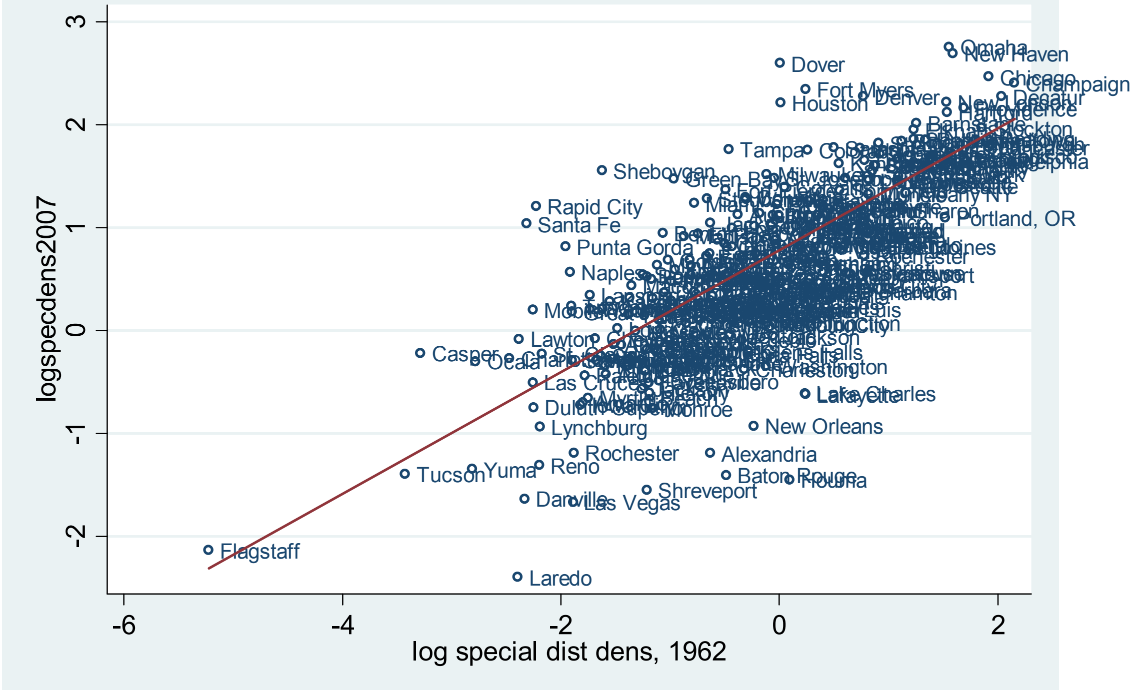


Figure 3.4: Local Governments and School Districts, 1962

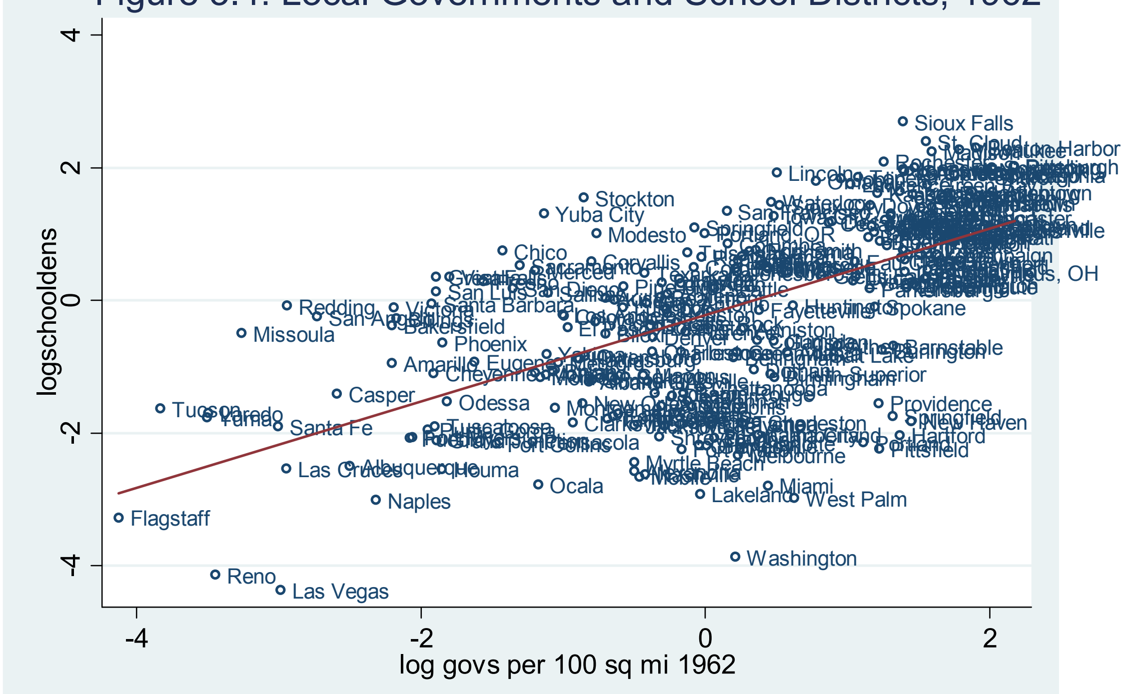


Figure 3.5: Fragmentation and Year of Statehood

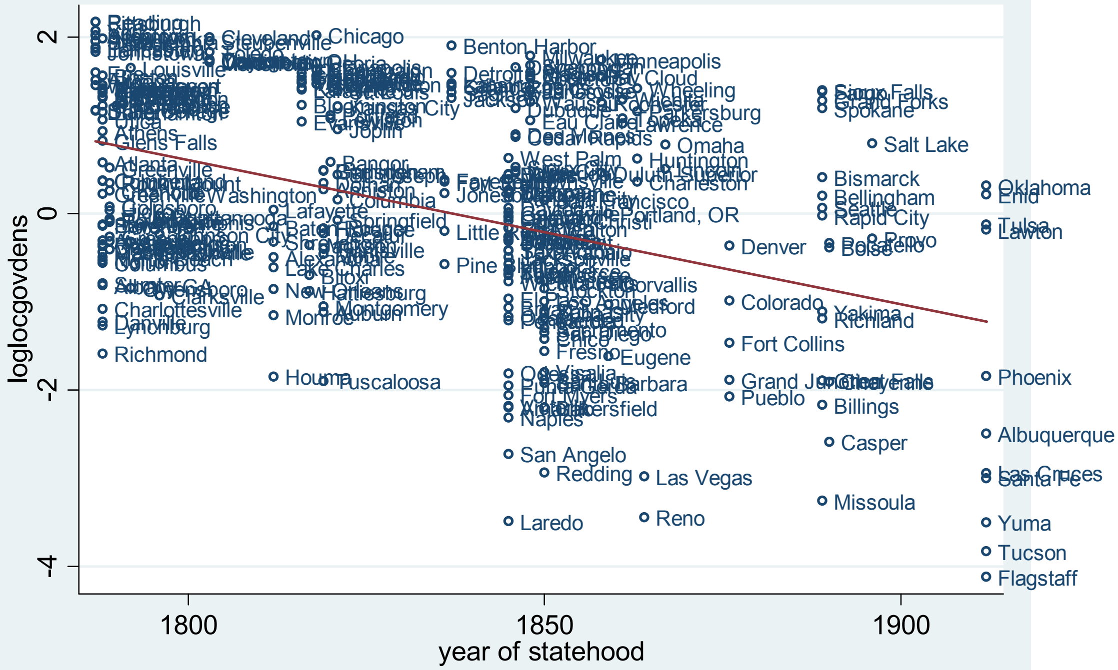


Figure 3.6: Fragmentation and January Temperature

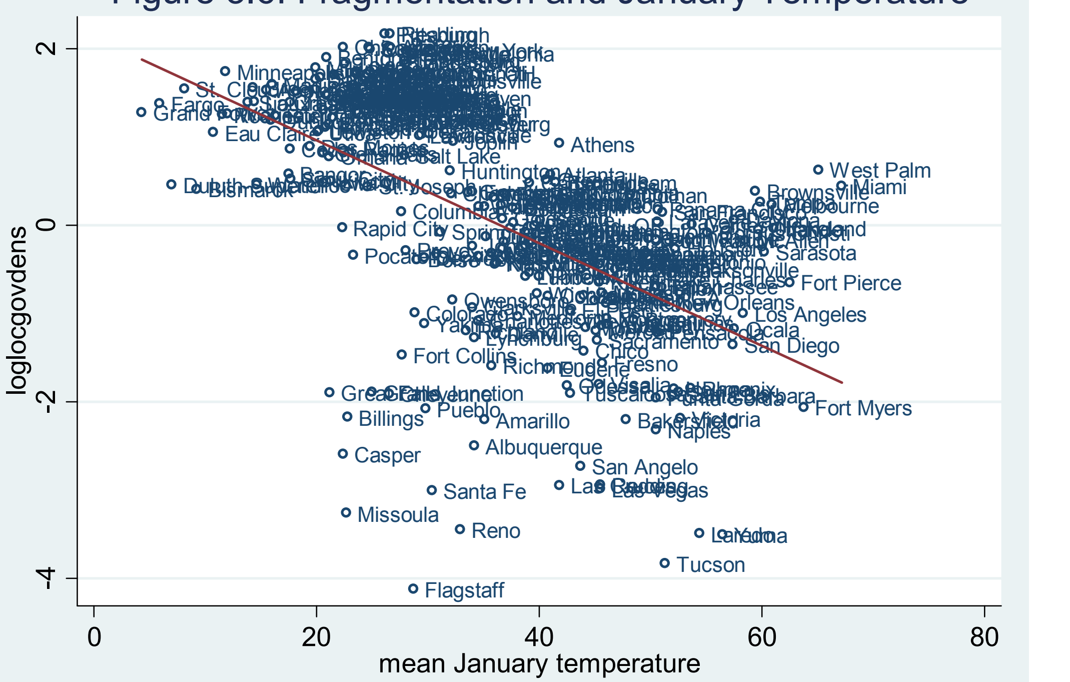


Figure 3.5 depicts the correlation of -0.43 between log government density and the year of statehood for the MSA's primary city. The 37 MSAs in the 13 original colonies average just over 3 local governments per 100 square miles, whereas that number is around 0.5 in the 17 MSAs in states that entered the Union in 1890 or later.[2] Figure 3.6 shows the similarly strong negative correlation of -0.56 between log local government density and the mean January temperature, where colder regions like the Northeast and Upper Midwest stand out for having both low winter temperatures and high levels of government fractionalization.

Figures 3.7 and 3.8 turn to historical population correlations. In looking at the impacts of government fractionalization throughout the paper I focus on changes over the period from 1970 to 2010, so it is worth benchmarking the relationship at the outset of this period. Figure 3.7 shows the 0.31 correlation between the log population in 1970 and log government density in 1962. Given that the local government map had been relatively fixed for some time even prior to 1962, I also compare how population in an earlier era relates to government density. Figure 10 examines the correlation of 1962 fractionalization with 1900 population levels. The earlier variable is actually a stronger correlate of government fractionalization, as the more recently settled, and hence more regionalized areas of the country experienced considerable catch-up growth during the early and middle parts of the twentieth century.

Figures 3.9 and 3.10 repeat the 1970 and 1900 comparisons, but this time for the share of the workforce employed in the manufacturing sector. Areas now referred to as the Rust Belt, such as Western Pennsylvania and cities surrounding the Great Lakes, had a large percentage of their employment concentrated in manufacturing both at the turn of the century and through to 1970, after which they were the hardest hit by the national decline in manufacturing. These areas tended to be convenient to ports and navigable rivers, and saw early settlement and growth compared to other regions of the country. Their levels of government fragmentation reflect this early settlement, and it will be important to account for the decline of manufacturing when teasing out the impacts of fractionalization on late 20th century outcomes.

[2] Alaska and Hawaii are omitted from the entire analysis due in part to their unique geographic character, as well as the lack of defined counties in early data in Alaska that makes maintaining consistent metro area boundaries impossible. The Anchorage MSA is in fact an example of a highly regionalized government, as its huge land area is governed centrally as a single unit. Given the differences between Alaska and the continental US it is unclear whether lessons from its experience could be expected to translate.

Figure 3.7: Fragmentation and Population in 1970

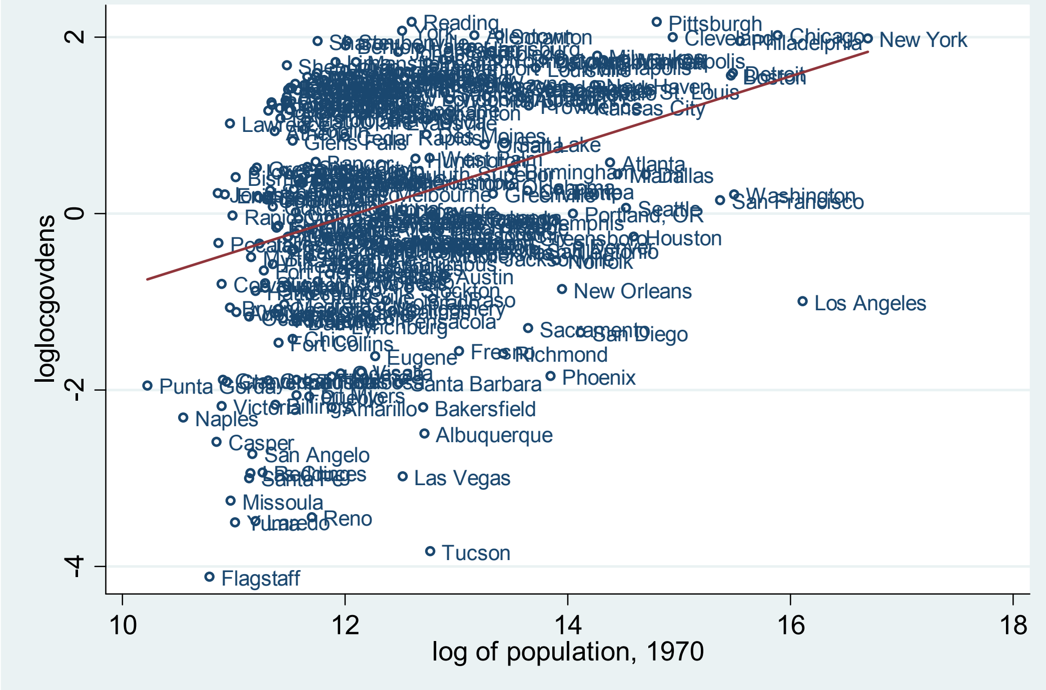


Figure 3.8: Fragmentation and Population in 1900

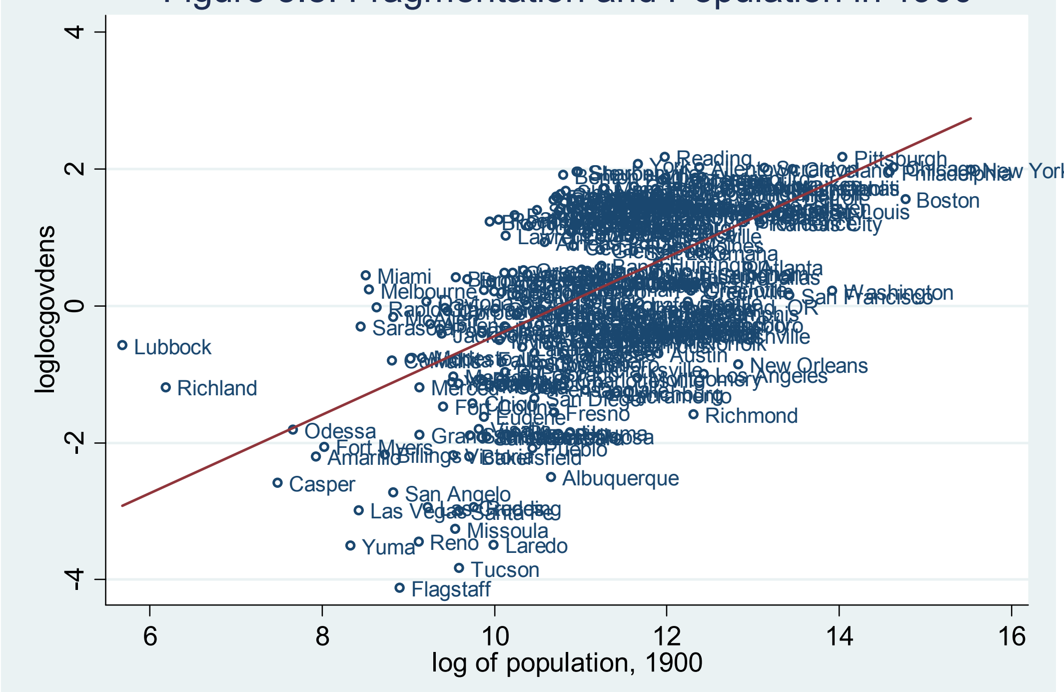


Figure 3.9: Fragmentation and Manufacturing in 1970

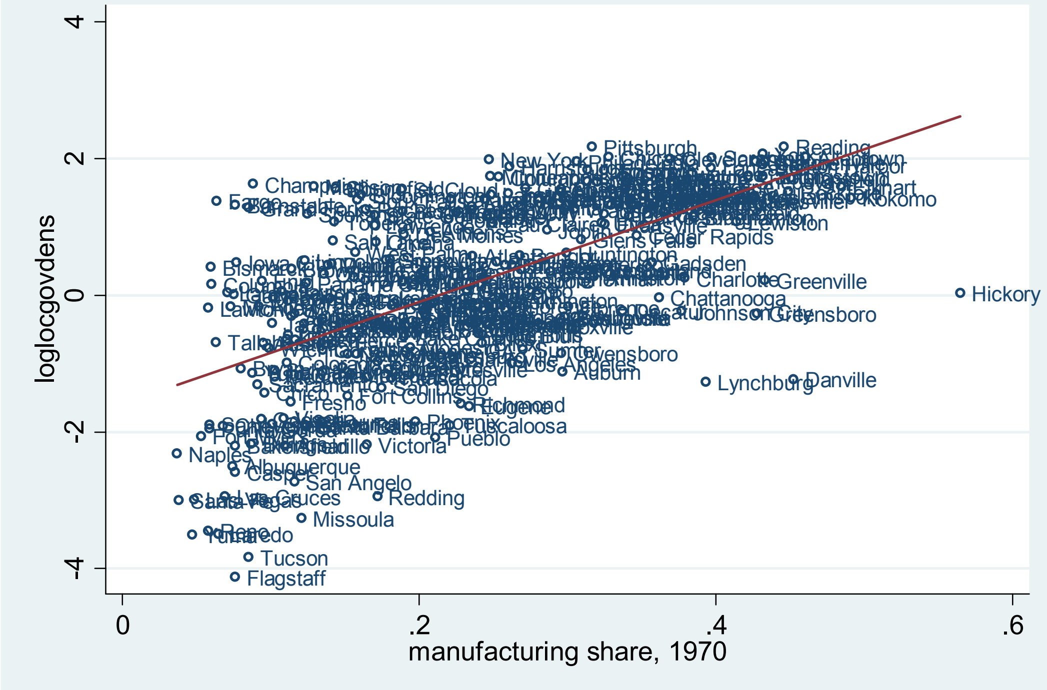


Figure 3.10: Fragmentation and Manufacturing in 1900

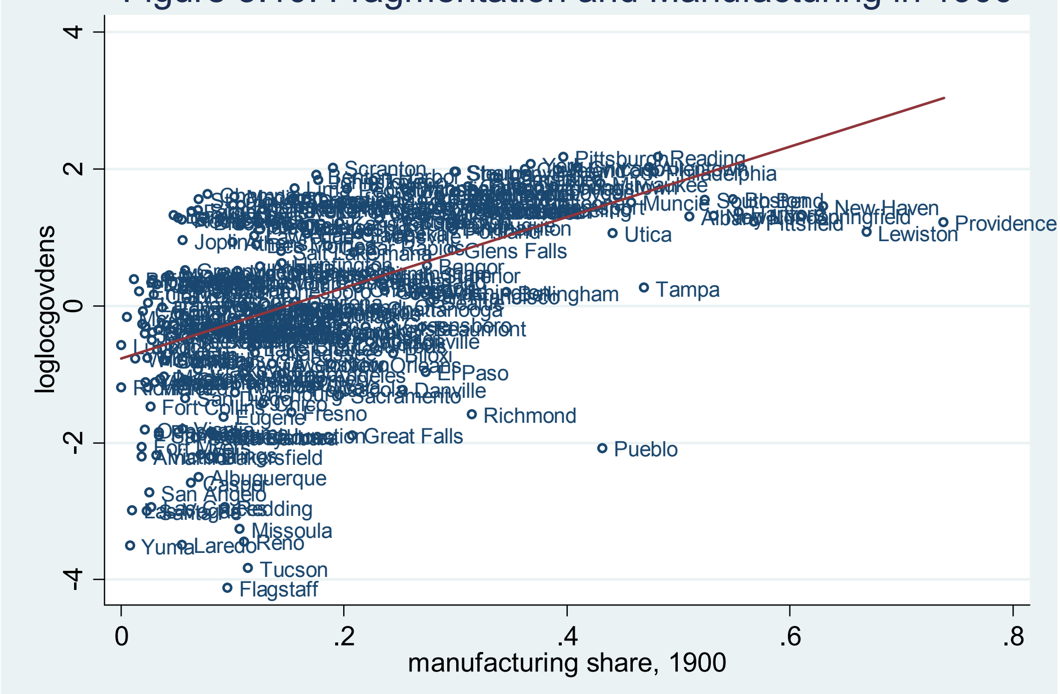


Figure 3.11: Fragmentation and BA Share in 1970

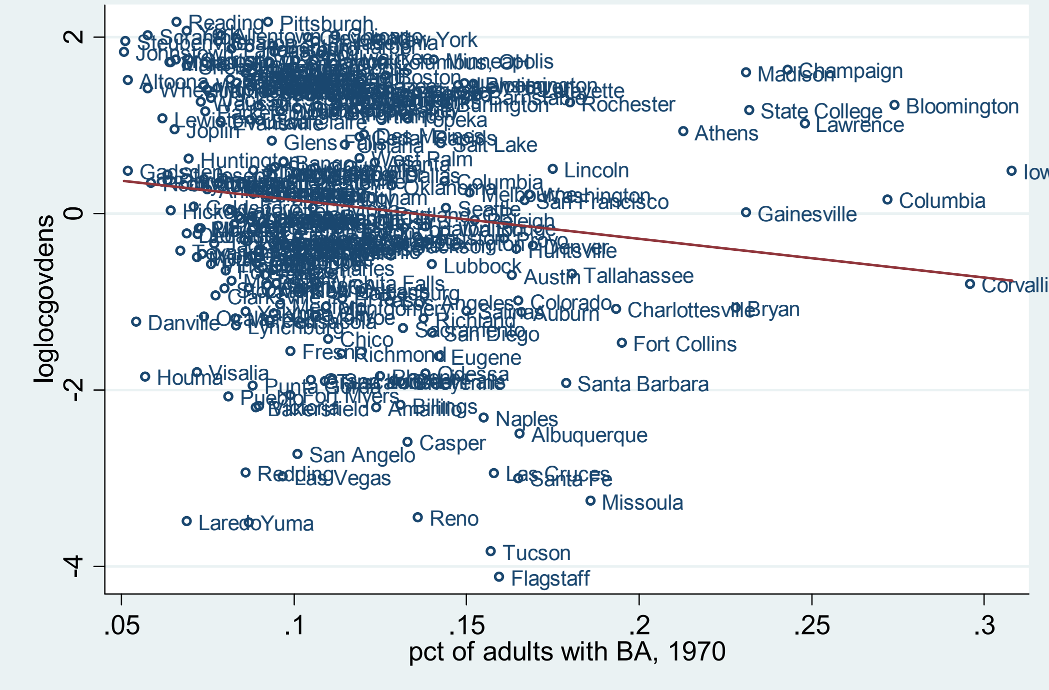
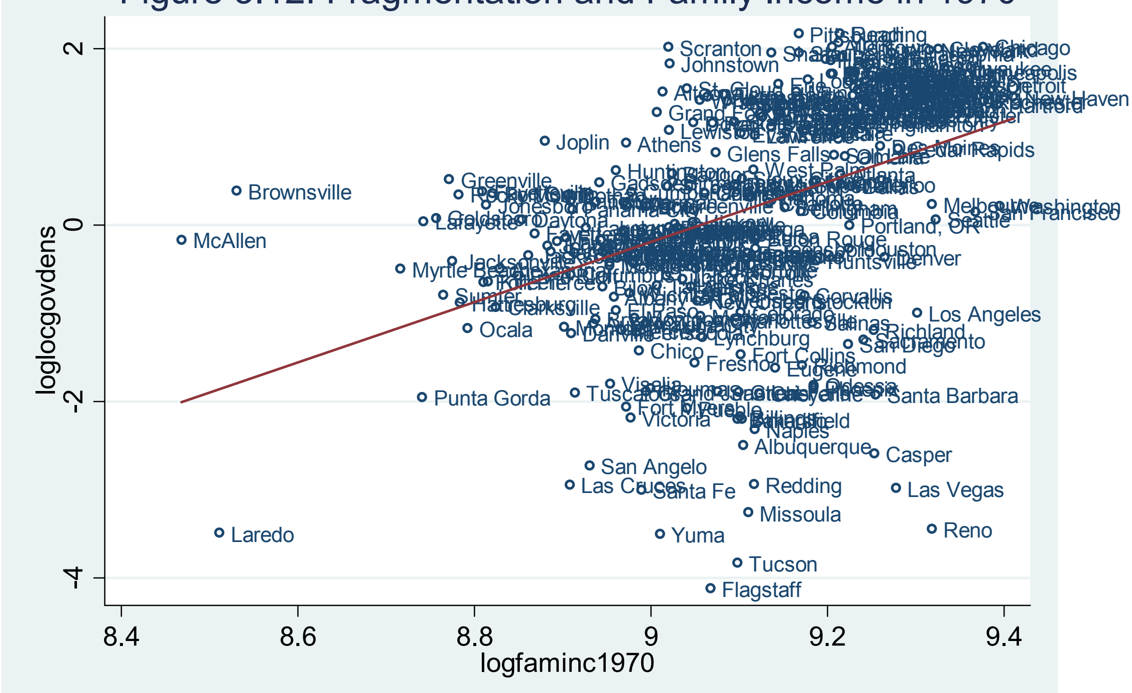


Figure 3.12: Fragmentation and Family Income in 1970



Finally, Figures 3.11 and 3.12 present the relatively modest -0.16 correlation between the percentage of adults holding bachelor's degrees in 1970 and log government density, and the stronger 0.41 correlation between log mean family income and log government density. Though areas with higher levels of fractionalization had lower levels of education, their nominal income levels were higher, likely reflecting the strong presence of manufacturing shown in the previous figures. As manufacturing has declined, urban fortunes have become more closely tied to area education levels, so the interplay between these variables merits attention in my examination of changes during the subsequent time period.

3.3 Hypotheses

In theory the impact of government fractionalization on metropolitan outcomes such as population and income growth is ambiguous. Proponents of a fractionalized system of metropolitan governance, starting with Tiebout (1956) argue that competition by a small jurisdictions fighting for residents will lead local governments to provide public goods more efficiently, thus advantaging the area as a whole in comparison to those with more regional governance. On the other hand, if there are returns to scale or externalities in the provision of the public goods, then larger regional governments might be better at coordinating resources to best serve their constituents. I outline the main arguments for each side here before turning to an evaluation of empirical evidence over the last forty years.

Tiebout's seminal paper posited that under the proper conditions, footloose residents voting with their feet between a sufficiently large number of jurisdictions could be expected to reach an equilibrium with efficient provision of public goods. This stood in contrast to the more pessimistic traditional analysis of public goods (e.g. Samuelson (1954)) which argued that a decentralized solution to the public goods problem was impossible. In Tiebout's argument, residents would express their willingness to pay for collective amenities by bidding up housing prices in areas that provided the public goods they desired. With the housing market thus serving as a revelation mechanism for amenity demand, communities could set taxes and amenity levels such that in equilibrium the marginal benefit of the amenities provided to the residents choosing to live in each community would precisely equal the marginal cost of providing those amenities.

Were Tiebout correct, and were the conditions he assumed to hold, then we might expect metropolitan areas with a greater number of local governments to grow at faster rates than those lacking intergovernmental competition, given their ability to more efficiently allocate public goods. This conclusion depends on the assumptions made about the mobility within and between metro areas. For instance, if movement across metro areas is assumed to be as costless as movement within, then regionally governed metro areas would be expected to behave like the smaller communities Tiebout describes, and there are no clear implications for growth. In fact, Tiebout envisions each of his communities having a U-shaped cost curve for public goods, implying an optimal size for each community that should be static in equilibrium.

Tiebout's optimistic conclusion turns out to be quite sensitive to his precise set of explicit and implicit assumptions. The subsequent theoretical literature found that an efficient equilibrium failed to exist for a variety of realistic interpretations of the local public goods problem. This culminated with Bewley (1981)'s paper in which he presented a set of counterexamples to argue that the only case in which a Tiebout equilibrium exists is the case where profit-maximizing governments produce public goods whose cost varies proportionally with population, where the number of governments exceeds the number of types of consumers, where utility does not depend on location, and where communities do not differ in resources or production functions. This restrictive case is unlikely to apply to most realistic problems of public good allocation.

While Tiebout's precise theoretical model may be inapplicable in most interesting cases, his insight that interjurisdictional competition could yield advantages in public good provision remains a compelling hypothesis and one that has garnered interest in the modern empirical literature (e.g. Hoxby (2000).) Finding a role for regionalism requires investigating the places where Tiebout's logic is most likely to break down. I explore several strands here.

Perhaps the most compelling argument for regionalism, and one Tiebout realized and explicitly assumed away, is that the economies of scale and external benefits of public goods may not fit tightly within the borders of small communities. The question of fractionalization versus regionalism comes down to whether the goods and services local governments provide tend to look like those Tiebout assumed. Local governments spent 1.66 trillion dollars in 2011, with education (600 billion), utilities such as water, gas, electric, sewer and waste management (210 billion), police and fire protection (126 billion), highways and transit (108 billion) and hospital (86 billion) making up the largest components of those expenditures.

Certainly some of these goods have benefits that extend across jurisdictional lines. Money spent on infrastructure for roads and utilities that extend across communities has benefits that are not neatly contained by jurisdictional borders. To the extent that user fees provide much of the financing for these categories of expenditure, matching the costs with the benefits of these services may be achievable at any level of government. Police and fire protection tend to be more localized, though fire departments do aid in the response to large fires in neighboring jurisdictions, and crime may either spillover or sort across borders, leading to interdependence between the levels of police protection across communities.

Given that education is the largest local expenditure it has drawn considerable attention in the literature. In their work on the growth of education over the 20th century, Goldin (2001), and Goldin and Katz (2008) point to the flexibility provided by small jurisdictions in explaining the early proliferation of secondary education in the United States. This flexibility came not only from the more localized governance of America compared to its European counterparts, but also the ease with which new school districts were created independently of existing jurisdictional boundaries.

Hoxby argues that the impact of Tiebout competition on education is positive in the modern period as well, using streams to instrument for government fractionalization within metropolitan areas. Her finding of positive results of competition on test scores has been controversial, and has been rebutted by Rothstein (2007). The strong correlations between many of the variables in the previous section suggest that the exclusion restriction for rivers may not hold, but nonetheless, the argument that Tiebout sorting has a positive impact on education remains a possibility.

The importance of school districts suggests my focus on towns and municipality governments may miss out on some of the benefits of localization that may occur at the school district level, though the fractionalization across these levels of government is highly correlated. On the other hand, Goldin and Katz point out that while Tiebout competition may once have been a virtue in the spread of public education, it may be a vice in the later era that I study when concerns about equal access to education became more prevalent. It may be that fractionalized jurisdictions adequately provide the private benefit of education to the children that reside within while underproviding the public component that comes from having a well-educated national population. Fernandez and Rogerson (1996) formalize this notion in a multi-generation model showing that relative to the Tiebout equilibrium, inducing wealthy individuals to move to poorer neighborhoods can lead to higher overall provision of education and greater wealth in every community in the subsequent generations.

This connects with a second argument against government fractionalization which argues that it leads to segregation. The Tiebout model sees the sorting of people by willingness to pay for amenities as beneficial in arriving at the proper allocation of public goods. However, if segregation of people along these lines has direct negative consequences then the rationale for fractionalization might be considerably undermined. Of particular focus has been the tendency for such sorting to occur along lines of race and class. Cutler and Glaeser (1999) test the impact of segregation on black outcomes across metro areas and find significant impacts on education, employment and single parenthood. However the large-scale experimental intervention in Moving to Opportunity (Kling et al., 2007) did not find support for the impact of neighborhood on these outcomes, though it did find impacts on mental health.

Not only might segregation be harmful in its own right, but exclusionary policies designed to achieve it may incur deadweight loss. Given that in reality the number of jurisdictions is unlikely to exceed the number of preference types, residents are not assured that those different than them will happily segregate themselves in their own neighborhood. As a result, communities often use zoning to exclude those who desire lower levels of housing consumption than incumbent residents. Such policies may be harmful through their impact on the segregation concerns above, but also on the overall supply of housing within a given distance of the city center.

Allowing space to play a more meaningful role in the model brings up additional concerns beyond exclusionary zoning. Tiebout explicitly rules out any relationship between residential location and employment opportunities, removing any role for the physical form of the city in his model. Regionalists, on the other hand, are often quite concerned with the impact of government fractionalization on employment decentralization and residential sprawl. If a primary driver of urban sprawl is an eagerness of residents to flee the fiscal obligations of living in a poor central city jurisdiction, then places with regional government might be expected to sprawl more slowly. The normative implications of sprawl are not clear (Glaeser and Kahn, 2004) but it is nonetheless worth investigating whether government fractionalization has an impact on it.

3.4 Results: The Impacts of Government Fractionalization

3.4.1 Density, Income and Rents

In Table 3.2 I examine the impact of government fractionalization on growth in population density from 1970 to 2010. To benchmark the results, in column 1 I measure the level of convergence over the period by regressing the log growth in population density over the period on its initial value in 1970. The coefficient of -0.1939 implies that an MSA twice as dense as another in 1970 would have been expected to grow about 20 percent more slowly over the forty year period.

Column 2 suggests that almost all of this convergence could be explained by including the log of the density of town and municipal governments in the MSA in 1962. Places with twice as many local governments would be expected to have grown about 17 percent less over the time period. Throughout this entire paper I cluster standard errors by state to allow for correlation in the error terms within a state. This correlation could arise for any number of reasons, but it is particularly important to account for when some of the variation in the dependent variable is driven by state-level policy, as is the case with government fractionalization given state incorporation and annexation laws.

Table 3.2: Population Growth and Government Fractionalization, 1970-2010

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Change in Log MSA Population Density (Residents Per Square Mile), 1970 to 2010									
Log of Local Governments		-0.1686**	-0.1077**	-0.0624	-0.0037		-0.0814	-0.0178	-0.0145	0.0326
Per Square Mile, 1960		[0.0281]	[0.0247]	[0.0360]	[0.0381]		[0.0426]	[0.0395]	[0.0308]	[0.0323]
Log of Population Density, 1970	-0.1989**	-0.0289	0.0234	-0.1243**	-0.0745*	-0.0983**	-0.0509	-0.0041	-0.1164*	-0.0710*
	[0.0300]	[0.0235]	[0.0298]	[0.0432]	[0.0306]	[0.0309]	[0.0266]	[0.0274]	[0.0478]	[0.0315]
Log of Manufacturing's Share			-0.3122**		-0.3021**			-0.3153**		-0.2824**
of Employment, 1970			[0.0891]		[0.0679]			[0.0903]		[0.0809]
Log of Mean January				0.2863	0.3123*				0.2766	0.2826
Temperature, 1961-1990				[0.1534]	[0.1187]				[0.2239]	[0.1746]
Log of Mean July Temperature				0.7254	0.4388				1.4163**	0.9788
Temperature, 1961-1990				[0.3800]	[0.3543]				[0.5239]	[0.4892]
Constant	1.4646**	0.6474**	-0.123	-3.034	-2.6228	0.9708**	0.7463**	-0.0024	-6.0408**	-4.8511**
	[0.1751]	[0.1179]	[0.2201]	[1.5717]	[1.4882]	[0.1863]	[0.1538]	[0.1867]	[1.9151]	[1.7314]
Region Fixed Effects	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES
Observations	275	275	275	275	275	275	275	275	275	275
R-squared	0.18	0.34	0.43	0.42	0.51	0.35	0.37	0.47	0.45	0.52

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Temperature data is from 1994 City and County Data Books. The remaining data comes from the US Census. Standard errors are clustered at the state level.

Recalling the strong historical correlations we saw in section 2 of the paper, we might worry the effect in column 2 is being driven by other variables correlated with both population growth and government fractionalization. Columns 3 through 5 explore this possibility. Column 3 controls for the share of the MSA's employment in the manufacturing sector in the base year of 1970, which is strongly related to a subsequent decline in the MSA's rate of growth. The share of the workforce in manufacturing in US metropolitan areas remained near its post-war peak at just over 25 percent of the workforce in 1970, but had fallen to less than half of that by the end of the period. The impact of the decline of manufacturing was certainly felt in places with higher shares - a place with twice the share of its workforce in manufacturing saw its growth fall by about a third. The inclusion of this variable also cuts the coefficient on local government fractionalization by about a third, though it remains highly significant.

Another prominent trend over the last 40 years has been the movement of the population towards places with warmer climates. The widespread adoption of air conditioning has made enduring warm July temperatures less taxing, allowing people to take advantage of the warmer January temperatures that often come with them. Including these in the regression along with the 1970 population density and the density of local governments lowers the coefficient on fractionalization to an insignificant -.06 log points. In column 5, with controls both for manufacturing and climate, the impact of local government fractionalization is reduced to zero, while all other variables enter with the expected sign. Accounting for these other powerful drivers of population growth over the last 40 years leaves little role for regionalism in explaining urban growth patterns.

Columns sixth through ten repeat the same regressions while including region fixed effects. All of the explanatory variables correlate strongly across regions, raising concerns that the regressions are picking up broad regional trends rather than the impacts of the variables themselves. Of course those regional trends may themselves be the result of the included variables, but finding strong intra-regional as well as inter-regional impacts would inspire more confidence about the variable's possible impact. Merely controlling for the 4 census regions reduces the coefficient on government fractionalization by half and renders it insignificant at the 5 percent level. Adding in the remaining explanatory variables further erodes the coefficient on regional governance, to the point where it is insignificantly positive by column 10. Comparing the other coefficients between columns 5 and 10 confirms that their impacts are fairly robust to region fixed effects, as the coefficients are little changed other than a doubling of the impact of July temperature. With both temperature variables included their impacts are somewhat imprecise within region, though including either one separately (not shown) yields significant positive coefficients.

Table 3.3 breaks these impacts down by decade. Columns one and two repeat exactly the regressions of the forty year growth in population density from Table 3.2 columns 2 and 10. The remaining columns run the same pair of regressions for each of the four decades. The sparse specification of density growth on government fractionalization and the initial density in 1970 presented in the odd columns shows reliably significant negative coefficients on government fractionalization, though the coefficient is about half the size in the latter two decades compared to the earlier ones. The saturated specification, adding region fixed effects as well as controls for initial share in manufacturing and January and July temperature shows reliably small and insignificant impacts of government fractionalization on density growth.

The decline in places high in manufacturing employment is particularly pronounced in the early decades, with a place with double the share of employment in manufacturing seeing about a ten percent fall in decadal growth in population density for both the seventies and eighties. The negative impacts of early manufacturing persist through the latter two decades as well, though at about half the size. July temperature is a particularly strong correlate of growth in the latter two decades.

Table 3.3: Population Growth and Government Fractionalization, 1970-2010 and by Decade

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Change in Log MSA Population Density (Residents Per Square Mile)									
	1970 to 2010		1970 to 1980		1980 to 1990		1990 to 2000		2000 to 2010	
Log of Local Governments	-0.1686**	0.0326	-0.0564**	0.0105	-0.0531**	-0.0001	-0.0342**	0.0082	-0.0249**	0.014
Per Square Mile, 1962	[0.0281]	[0.0323]	[0.0097]	[0.0093]	[0.0106]	[0.0107]	[0.0071]	[0.0088]	[0.0056]	[0.0077]
Log of Population	-0.0289	-0.0710*	-0.0278**	-0.0486**	0.0136	-0.0022	-0.0058	-0.0104	-0.0088	-0.0099
Density, 1970	[0.0235]	[0.0315]	[0.0071]	[0.0095]	[0.0090]	[0.0131]	[0.0064]	[0.0075]	[0.0064]	[0.0067]
Log of Manuf. Share		-0.2824**		-0.0916**		-0.1029**		-0.0423*		-0.0455**
of Employment, 1970		[0.0809]		[0.0340]		[0.0259]		[0.0175]		[0.0114]
Log Mean January Temp,		0.2826		0.124		0.1418*		0.0253		-0.0084
1961-1990		[0.1746]		[0.0660]		[0.0658]		[0.0335]		[0.0222]
Log Mean July Temp,		0.9788		0.0953		0.0691		0.4158**		0.3987**
1961-1990		[0.4892]		[0.1851]		[0.1693]		[0.1361]		[0.0769]
Constant	0.6474**	-4.8511**	0.3072**	-0.5897	0.0404	-0.8463	0.1540**	-1.7880**	0.1458**	-1.6271**
	[0.1179]	[1.7314]	[0.0356]	[0.6004]	[0.0455]	[0.6107]	[0.0335]	[0.5571]	[0.0298]	[0.3088]
Region Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	275	275	275	275	275	275	275	275	275	275
R-squared	0.34	0.52	0.42	0.59	0.24	0.46	0.24	0.39	0.2	0.37

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Temperature data is from 1994 City and County Data Books. The remaining data comes from the US Census. Standard errors are clustered at the state level.

Tables 3.4 through 3.6 repeat the same set of decadal regressions for mean household income, mean rent and mean real income. Following Rosen (1979) and Roback (1982), growth in income and rents can used to discern whether areas are changing with respect to amenities useful in production and consumption. If an area has features that make labor increasingly productive there then nominal incomes for equivalently skilled workers will rise to attract workers to the more productive location. At the same time, holding consumption amenities constant, rents must also rise such that the marginal worker's real wage remains constant across all locations. Consumption amenities, in contrast, must lower the real wage, such that the higher real wages in low amenity areas compensate workers for the cost of foregoing better amenities elsewhere. This fall in real income is accomplished by bidding up rents in high amenity locations, as well as expanding the labor force in these areas, moving outwards along the downward sloping local labor demand curve, and thus lowering nominal wages.

If greater regional cooperation on infrastructure allows areas to increase firm and worker productivity over time then we would expect the impact of government fractionalization on nominal incomes to be positive. Higher levels of human capital could also lead to higher incomes, so if Tiebout sorting leads to higher educational attainment, or vice versa as suggested by Fernandez and Rogerson (1996), that might be reflected in area mean income. I will return to a more direct examination of educational attainment below.

The forty year regressions for the growth in the log of mean family income in columns one and two suggest that fractionalization plays only a small role in explaining changes in area incomes. As was true of population density, a regression of log income growth on government density and log initial income yields a significant negative coefficient, though even in this sparse specification the magnitude of the coefficient is small at negative 2.4 log points over a forty year period. In contrast, convergence in incomes across MSAs has been quite strong over the period at negative 30 log points.

Table 3.4: Income Growth and Government Fractionalization, 1970-2010 and by Decade

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Change in Log Mean Family Income									
	1970 to 2010		1970 to 1980		1980 to 1990		1990 to 2000		2000 to 2010	
Log of Local Governments	-0.0240**	0.0172	-0.0037	0.002	0.0068	0.0088	0.0029	0.007	-0.0300**	-0.0005
Per Square Mile, 1962	[0.0077]	[0.0097]	[0.0053]	[0.0048]	[0.0079]	[0.0093]	[0.0050]	[0.0042]	[0.0069]	[0.0050]
Log of Mean Family	-0.2977**	-0.1387	-0.2310**	-0.1796**	0.0171	0.0958	-0.0735**	-0.0889**	-0.0103	0.034
Income, 1970	[0.0696]	[0.0727]	[0.0260]	[0.0350]	[0.0734]	[0.0528]	[0.0248]	[0.0137]	[0.0566]	[0.0413]
Log of Manuf. Share		-0.0993**		-0.0169		-0.0285		-0.0116		-0.0423**
of Employment, 1970		[0.0139]		[0.0092]		[0.0190]		[0.0059]		[0.0121]
Log Mean January Temp,		0.0264		-0.0340*		0.0800*		-0.0370*		0.0174
1961-1990		[0.0434]		[0.0168]		[0.0374]		[0.0150]		[0.0262]
Log Mean July Temp,		-0.0155		0.0105		-0.3258*		-0.0243		0.3241**
1961-1990		[0.2356]		[0.0860]		[0.1296]		[0.0789]		[0.1049]
Constant	4.4457**	2.8103*	2.8640**	2.4412**	0.3858	0.7604	1.0337**	1.3873**	0.1622	-1.7786**
	[0.6300]	[1.0784]	[0.2343]	[0.4542]	[0.6711]	[0.7446]	[0.2214]	[0.3263]	[0.5132]	[0.5362]
Region Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	275	275	275	275	275	275	275	275	275	275
R-squared	0.27	0.44	0.32	0.41	0.01	0.19	0.06	0.31	0.25	0.47

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Temperature data is from 1994 City and County Data Books. The remaining data comes from the US Census. The 2010 value for mean family income reflects the American Community Survey 5-year average from 2006 to 2010. Standard errors are clustered at the state level.

Adding in the initial manufacturing share, the temperature variables and region fixed effects switches the sign of the impact of government fractionalization to an insignificant positive. Not surprisingly, places high in manufacturing in the 1970 saw slower income growth in subsequent decades. Temperature, while a strong predictor of population growth, seems to have little impact on income growth, consistent with the view that temperature is more beneficial in consumption rather than production. The decadal regressions offer nothing to suggest an impact of fractionalization on income growth at any point in the time period. Among the only coefficients of note are those on the initial level of household income, showing particularly strong convergence between 1970 and 1980. This could be interpreted in two ways. Either it could be viewed as suggesting strong short run mean reversion in area income such that gaps are erased within 10 years, or it might suggest that longer run trends in area income, which have been noted by authors (Barro and Sala-I-Martin, 1991) were drawing to a close by around 1980.

Next, I turn to area rents, measured as the mean gross rent (inclusive of utilities) for all apartments in a metro area. Changes in rent could be driven by changes in production and consumption amenities, as suggested by the Roback model, though increasingly the literature has pointed to the importance of housing supply factors such as land use restrictions in explaining dynamics in the housing market (Glaeser et al., 2005). Augmenting the Roback model with a housing supply curve that varies between markets means that in markets with few barriers to construction any growth in productivity or quality of life factors will be reflected in population growth rather than rental price growth, whereas the opposite will be true in restricted housing markets.

Land use has become an increasing focus of the regionalism literature, particularly among those concerned about urban sprawl. If, as has been suggested, competition between jurisdictions encourages communities to employ exclusionary zoning policies, then government fractionalization may lead to steeper housing supply curves and greater increases in rents conditional on other outcomes. Of course piecemeal zoning restrictions are not the only type of land use restriction, and regional governments are quite capable of themselves limiting construction. Many point to coordinated regional efforts to preserve green space in places such as Portland, Oregon, and Silicon Valley, as examples of successful regional planning. While these types of policies may be successful in maintaining greenery, their results could lead to reduced housing supply and increasing prices in the absence of other strategies for expanding supply. Portland, by some accounts, has avoided these outcomes by requiring increasing density within its urban growth boundary (see Downs (2002)) but Silicon Valley has seen some of the fastest rising housing prices in the country.

While attempts to measure zoning stringency are complicated by the wide array of regulations available to local governments, the Wharton Residential Land Use Survey (Gyourko et al., 2008) provides several metrics along which jurisdictions can be compared. Aggregating these up to the metro area level, Figures 3.13 and 3.14 show the correlations between two of their measures and government fractionalization. In Figure 3.13, their composite measure, aggregating factors like presence of explicit supply and density restrictions, as well as the number of local decision makers involved in the permitting process, shows almost no relationship with fractionalization (correlation -0.12). On the right, the average permit delay, a measure of regulatory red tape, also shows no clear relationship with the density of local governments (correlation -0.04). Any relationship between land use and regionalism is either too subtle or cross-cutting to show up in these highly aggregated metrics.

Table 3.5 presents the decadal results of regressions of the growth in log mean rent on log government density and other correlates of urban growth. Consistent with the lack of clear relationship between fractionalization and supply restrictiveness, no consistent relationship between rent growth and government density emerges. The sparse regression in column 1 shows a significant negative impact of fractionalization on rent growth over the 40 year period, but adding regional fixed effects and controls for manufacturing share and temperature pushes the coefficient to zero. Early manufacturing seems to predict rent declines while January temperature predicts rent increases, consistent with the first being a negative shock to productivity and the latter being an increasingly valued consumption amenity.

Figure 3.13: Wharton Land Use Index and Fragmentation

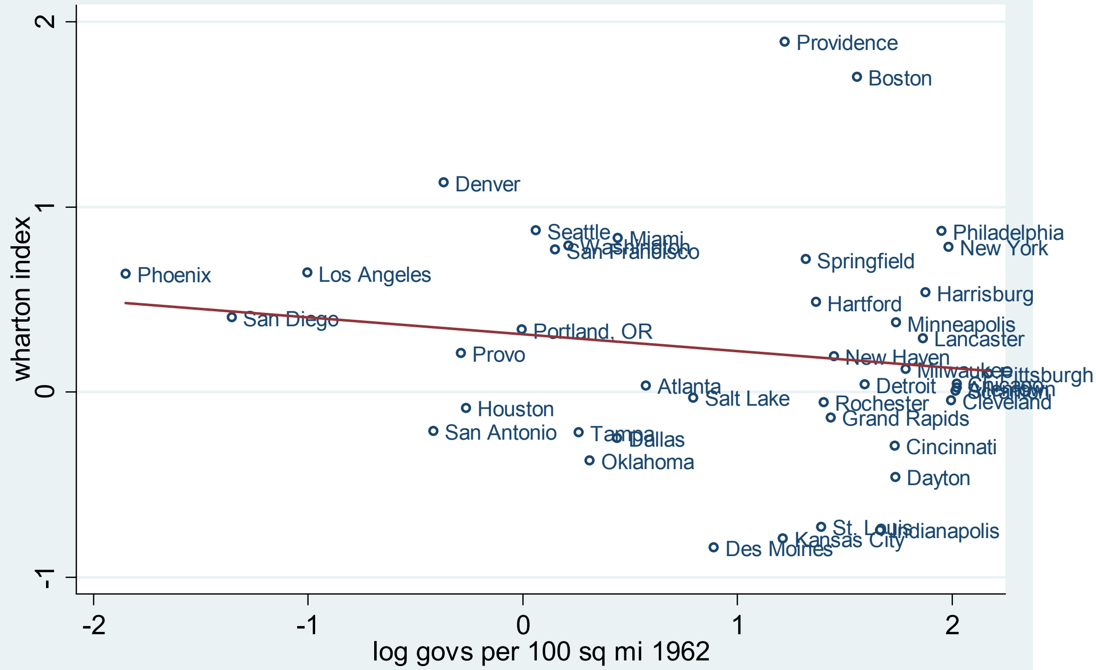


Figure 3.14: Average Permit Delay and Fragmentation

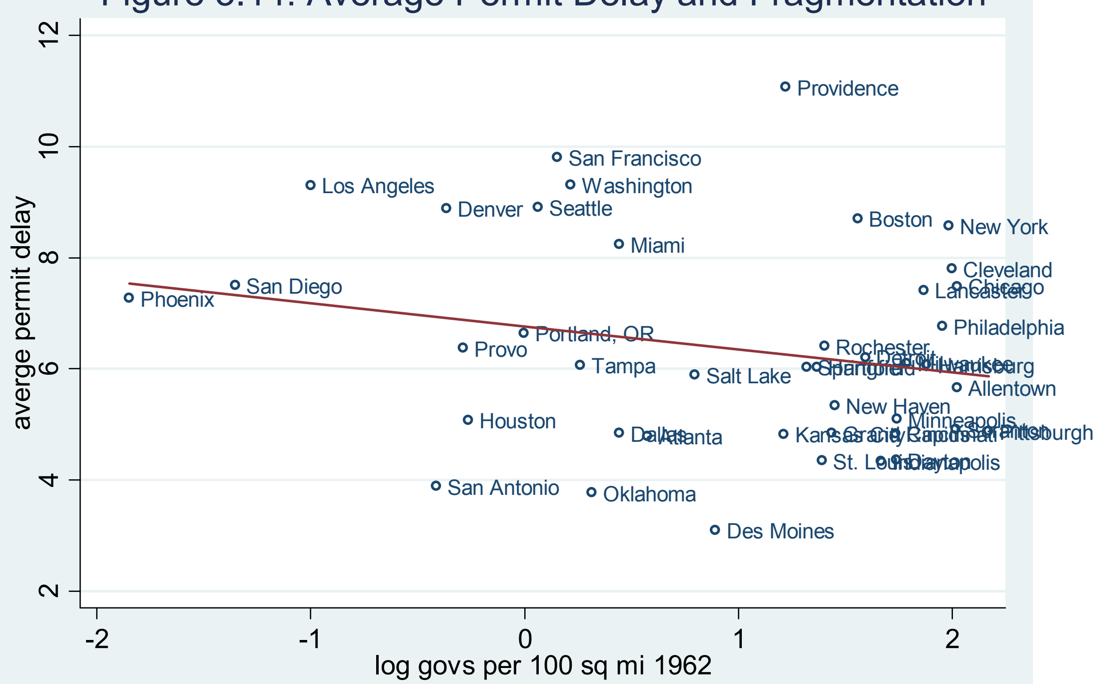


Table 3.5: Growth in Rent and Government Fractionalization, 1970 to 2010 and by Decade

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Change in Log Mean Rent									
	1970 to 2010		1970 to 1980		1980 to 1990		1990 to 2000		2000 to 2010	
Log of Local Governments	-0.0608**	0.0051	-0.0243**	-0.0053	0.0012	0.0026	-0.0150*	0.0071	-0.0227*	0.0007
Per Square Mile, 1962	[0.0150]	[0.0132]	[0.0045]	[0.0060]	[0.0110]	[0.0100]	[0.0070]	[0.0083]	[0.0085]	[0.0065]
Log of Mean Rent, 1970	-0.0677	-0.0554	-0.4609**	-0.4696**	0.1646*	0.2266**	0.1635**	0.1138**	0.0652	0.0739*
	[0.0949]	[0.0578]	[0.0255]	[0.0245]	[0.0679]	[0.0571]	[0.0339]	[0.0271]	[0.0403]	[0.0288]
Log of Manuf. Share		-0.0816**		-0.0318**		-0.0043		-0.0008		-0.0448**
of Employment, 1970		[0.0228]		[0.0082]		[0.0148]		[0.0147]		[0.0113]
Log Mean January Temp,		0.1783*		0.0428*		0.1450**		-0.0731*		0.0636
1961-1990		[0.0750]		[0.0210]		[0.0485]		[0.0295]		[0.0347]
Log Mean July Temp,		-0.2929		-0.0344		-0.2883*		-0.0591		0.0888
1961-1990		[0.2887]		[0.1300]		[0.1240]		[0.1413]		[0.1050]
Constant	2.1373**	2.5940*	2.9592**	2.9458**	-0.2091	0.248	-0.6228**	0.1103	0.01	-0.7103
	[0.4207]	[1.1698]	[0.1186]	[0.5358]	[0.3006]	[0.5958]	[0.1504]	[0.6141]	[0.1760]	[0.5060]
Region Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	275	275	275	275	275	275	275	275	275	275
R-squared	0.22	0.48	0.64	0.67	0.06	0.31	0.13	0.32	0.13	0.33

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Temperature data is from 1994 City and County Data Books. The remaining data comes from the US Census. The 2010 value for mean gross rent (inclusive of utilities) reflects the American Community Survey 5-year average from 2006 to 2010. Standard errors are clustered at the state level.

Table 3.6 completes the analysis of the implications of the Roback model by investigating differences in real income. Following Moretti (2013), I calculate area price level as a weighted average of the national price level and the local rent in a given year, with the weight on local rent determined by a regression of variation of the local CPI on local rent levels for areas where a local CPI is calculated. This allows for the fact that prices of locally consumed goods other than housing will reflect the higher rents that local merchants face. In practice about a third of the non-housing consumption bundle varies systematically with housing prices, and adding that to the 42 percent of income spent on housing directly yields a weight of 0.62 on local rents and 0.38 on a common price level.

Subtracting the log of the price level from the log of mean nominal income yields the log of mean real income for each metro area. Not surprisingly, given the lack of strong relationships in Tables 3.4 and 3.5, the impact of local government density on real income is weak. In the sparse regression for the forty year period it is a weak but significantly positive 1.6 log points, and this falls to an insignificant 1 log point in the more saturated specification. The coefficients on government density across decades, though occasionally significant, are never large in magnitude. The coefficients on the remaining variables take the expected sign, with manufacturing, presumably related only to production, having little impact whereas a high January temperature has been associated with decreasing real incomes. Perhaps surprisingly, the disamenity value of warm summers appears to be growing over the last decades, as the real income has grown sharply in places with high July temperatures since 1990.

Table 3.6: Growth in Real Income and Government Fractionalization, 1970 to 2010 and by Decade

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Change in Log Mean Real Income									
	1970 to 2010		1970 to 1980		1980 to 1990		1990 to 2000		2000 to 2010	
Log of Local Governments	0.0158*	0.0103	0.0152**	0.0122**	0.0094*	0.0026	0.0114**	-0.003	-0.0203**	-0.0015
Per Square Mile, 1962	[0.0075]	[0.0076]	[0.0045]	[0.0045]	[0.0040]	[0.0054]	[0.0034]	[0.0042]	[0.0034]	[0.0059]
Log of Mean Real	-0.4663**	-0.4063**	-0.2291**	-0.2294**	-0.1619**	-0.2044**	-0.1580**	-0.1092*	0.0827	0.1367**
Income, 1970	[0.0737]	[0.0578]	[0.0397]	[0.0386]	[0.0583]	[0.0662]	[0.0324]	[0.0455]	[0.0710]	[0.0462]
Log of Manuf. Share		-0.0153		-0.0107		0.0158		0.0033		-0.0236
of Employment, 1970		[0.0133]		[0.0077]		[0.0129]		[0.0106]		[0.0135]
Log Mean January Temp,		-0.1127**		-0.0402*		-0.0386		-0.0092		-0.0248
1961-1990		[0.0321]		[0.0163]		[0.0223]		[0.0126]		[0.0201]
Log Mean July Temp,		0.2850**		-0.068		-0.0336		0.1001*		0.2865**
1961-1990		[0.0904]		[0.0514]		[0.0807]		[0.0426]		[0.1031]
Constant	5.9816**	4.5666**	2.8431**	3.2625**	2.0165**	2.7091**	1.8034**	0.9644*	-0.6813	-2.3694**
	[0.6731]	[0.5973]	[0.3620]	[0.4410]	[0.5315]	[0.6076]	[0.2928]	[0.4598]	[0.6512]	[0.4398]
Region Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	275	275	275	275	275	275	275	275	275	275
R-squared	0.27	0.43	0.17	0.4	0.09	0.14	0.13	0.36	0.15	0.26

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Temperature data is from 1994 City and County Data Books. The remaining data comes from the US Census. The 2010 values for mean family income and mean rent reflect American Community Survey 5-year average from 2006 to 2010. Real income is calculated, following Moretti (2013), as a weighted average of a fixed national price level and mean rent, with the weights of 0.38 and 0.62 reflecting the portion of variation in local CPIs that varies directly with area rents. Standard errors are clustered at the state level.

Taken as a whole, the results for growth in population, income and rent show little reason to believe that regionalism has had a strong impact on these core measures of urban performance over the past four decades. This conclusion comes with a fair number of caveats. The high level of correlation between government fractionalization and other urban factors renders any conclusion tentative. Ideally we might have randomly assigned governance structures, or at the very least been blessed with a greater level of intra-regional variation than is present. Given that some areas, such as Southwest are almost entirely highly regionalized whereas the Northeast is almost entirely highly fractionalized, controlling for region effects could be eliminating some variation that is actually being driven by government fractionalization. The lack of a relationship within the narrower bands of variation available within regions, or among places with historically similar industrial compositions, casts doubt on this hypothesis, but it certainly does not rule it out.

It can also be argued that the number of town and municipal governments may be too crude a metric of regionalism, and that the impact of regional governance is attenuated by measurement error compared to a purer measure of the concept. Certainly the number of state and local governments in 1962 gives far from a complete picture of the variety of forms that local and regional governance can take. In the backdrop of these more stable forms of local government are a more volatile set of school districts and special districts that have grown and contracted more rapidly in some places than others. Moreover, given the limits on annexation and merging present in state laws, most advocates of regionalism push not for the unification of local governments but for cooperation between them in the form of pacts or extra-governmental authorities such as the Metropolitan Council in the Twin Cities or the Portland Metro in Portland, Oregon. While merely counting the number of local governments per square mile ignores these subtleties, it also would seem to capture the most binding and permanent distinctions in the level of regional governance across places. If a particular type of regional cooperation were shown to have a strong impact on the outcomes studied, the results here suggest that we should be cautious in seeing that as a triumph of regionalism at large, rather than a vindication of one particular regional policy.

3.4.2 Educational Attainment, Segregation and Sprawl

Having found little evidence in support of a strong influence of government fragmentation on broad urban outcomes like population and income growth, I now turn to three topics that have gained particular focus in the literature on fractionalization and regionalism. First, I examine the relationship between local government density and the adult population's education level. I then turn to topics of segregation and sprawl.

The impact of fractionalization on educational attainment has been hotly contested (see Hoxby (2000) and Rothstein (2007).) Even if government fractionalization were to have an impact on educational attainment of children and college students, what that implies about cross metro area differences in the education level of the adult population is less clear. Given a national labor market, there need not be a connection between an area's production of educated workers and its subsequent ability to retain them, and some empirical evidence confirms that this connection is at best tenuous (Bound et al., 2004). The education level of the adult population is more likely to reflect area skill demands and the differential appeal of certain types of amenities to workers of different education levels (see Diamond (2012), for a recent exploration of these issues.) Has government fractionalization had an impact on these variables in the recent period?

Table 3.7 suggests an affirmative answer to this question. Column 1 shows the 40 year growth in the log of the percent of the population 25 and over with a bachelor's degree regressed on the log of local government density and the percent of adults with bachelor's degree in 1970. The coefficient on government fractionalization implies that a doubling of the local government density would have led to a 5 percent increase in the BA share of the adult population, and this result is highly significant. Adding in controls for the initial manufacturing share and climate variables as well as regional fixed effects reduces the coefficient to 2.8 log point, but it remains significant at the 5 percent level. Given that doubling the government density is roughly a one standard deviation movement when the variable is at its mean level, a resulting 2.8 percent increase in the BA share is small but still meaningful. This impact seems to be heavily concentrated in the two earlier decades rather than the more recent period.

Table 3.7: Growth in Share of Adults with a Bachelors Degree and Government Fractionalization

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Change in Log Percent of Population Age 25 and Over with a Bachelors Degree									
	1970 to 2010		1970 to 1980		1980 to 1990		1990 to 2000		2000 to 2010	
Log of Local Governments	0.0529**	0.0276*	0.0146**	0.0164**	0.0186**	0.0073*	0.0144**	0.0007	0.0053*	0.0031
Per Square Mile, 1962	[0.0089]	[0.0113]	[0.0034]	[0.0059]	[0.0034]	[0.0035]	[0.0047]	[0.0063]	[0.0026]	[0.0042]
Log of Pct of Adults	-0.2368**	-0.2170**	-0.1070**	-0.1194**	-0.0323*	-0.0013	-0.0384**	-0.0308	-0.0590**	-0.0656**
with a BA, 1970	[0.0330]	[0.0401]	[0.0176]	[0.0220]	[0.0129]	[0.0130]	[0.0134]	[0.0205]	[0.0088]	[0.0101]
Log of Manuf. Share		0.032		-0.0093		0.0296**		0.0186		-0.0069
of Employment, 1970		[0.0287]		[0.0145]		[0.0085]		[0.0170]		[0.0083]
Log Mean January Temp,		-0.0246		-0.0356		0.0159		-0.0066		0.0016
1961-1990		[0.0333]		[0.0211]		[0.0133]		[0.0245]		[0.0130]
Log Mean July Temp,		-0.4102*		-0.1219		-0.085		-0.1766		-0.0267
1961-1990		[0.2030]		[0.1319]		[0.0835]		[0.0948]		[0.0680]
Constant	0.3278**	2.2914*	0.1475**	0.7562	0.1082**	0.541	0.0818**	0.9193*	-0.0097	0.0749
	[0.0707]	[0.8703]	[0.0409]	[0.5370]	[0.0286]	[0.3417]	[0.0285]	[0.3778]	[0.0183]	[0.2843]
Region Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	275	275	275	275	275	275	275	275	275	275
R-squared	0.38	0.42	0.24	0.27	0.19	0.33	0.14	0.19	0.22	0.25

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Temperature data is from 1994 City and County Data Books. The remaining data comes from the US Census. The 2010 value for BA share reflects the American Community Survey 5-year average from 2006 to 2010. Standard errors are clustered at the state level.

Table 3.8 shows a similar impact of government fractionalization on BA attainment amongst those born in an area. While data on the metro area of birth is not available, state of birth is available from the census IPUMS data. States with twice the level of local government fractionalization, as measured by local governments per square mile, saw the share of adults born there with bachelor's degrees increase by between 6 percent more than would have otherwise been expected from 1970 to 2010, and this result is robust to the inclusion of regional fixed effects. Again the earlier decades seem to show the strongest results.

This suggests that one possibility for the results in Table 3.7 is that Tiebout sorting did indeed drive improvements in the local provision of education, and that at least some of these educated workers chose to stick in their home state regardless of other opportunities. Again, given the level of mobility across MSAs, particularly among the college educated, it is hard to imagine that stasis is the primary driver. More likely, producing a highly educated population is related to either production or consumption amenities attractive to educated workers. One possibility could be that highly educated workers are drawn to more fractionalized MSAs because they provide a greater number of small, relatively affluent suburbs with high performing schools. While the literature on Tiebout sorting views homogeneous suburbs as having a strong appeal to the affluent within metro areas, little attention has been devoted to the impact of their appeal on cross-MSA mobility.

Table 3.8: Growth in Share of Adults with BA and Government Fractionalization of Home State

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Change in Log Percent of Adults Born in the State with a Bachelors Degree									
	1970 to 2010		1970 to 1980		1980 to 1990		1990 to 2000		2000 to 2010	
Log of Local Governments	0.0598**	0.0526**	0.0153**	0.0291*	0.0271**	0.0132	0.0091*	0.0003	0.0083**	0.01
Per Square Mile, 1962	[0.0077]	[0.0188]	[0.0055]	[0.0132]	[0.0044]	[0.0102]	[0.0035]	[0.0085]	[0.0024]	[0.0057]
Log of Pct of Adults	-0.4854**	-0.5030**	-0.1683**	-0.1747**	-0.1356**	-0.1302**	-0.1062**	-0.1190**	-0.0754**	-0.0791**
with a BA, 1970	[0.0392]	[0.0658]	[0.0279]	[0.0464]	[0.0222]	[0.0357]	[0.0180]	[0.0297]	[0.0120]	[0.0200]
Constant	-0.1851*	-0.2243	-0.0099	-0.0235	-0.096	-0.0846	-0.0431	-0.0718	-0.0361	-0.0443
	[0.0874]	[0.1459]	[0.0622]	[0.1028]	[0.0496]	[0.0791]	[0.0401]	[0.0658]	[0.0268]	[0.0444]
Region Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	48	48	48	48	48	48	48	48	48	48
R-squared	0.84	0.84	0.51	0.53	0.65	0.69	0.49	0.53	0.55	0.57

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Temperature data is from 1994 City and County Data Books. The remaining data comes from the US Census accessed using the IPUMS files (https://www.ipums.org)

Turning to the impacts of fractionalization on segregation within metro areas, in Table 3.9 I compare the impact of local government density on the segregation of the black population in 1970 and 2010. The finding that the number of local governments in an area is a strong predictor of black segregation has been found before (Cutler and Glaeser, 1999), and the result is confirmed here for both time periods with and without regional fixed effects. To measure segregation I use the dissimilarity index, which is defined over two races and asks what percentage of one race would have to move in order for all neighborhoods to have a share of that race equal to the MSA share. I use black and non-black as the two racial categories, and define neighborhoods as census tracts, consistently defined over the period from 1970 to 2010 using the Longitudinal Tract Database. Census tracts covered only metro areas in the 1970 and 1980 censuses, so areas that have only recently become part of metro areas are not included in the data, limiting my sample to 221 areas.

Interestingly, in 1970 the effect goes away upon controlling for the black share of the population and the overall size of the population. While the measure is not mechanically related to the size of the black population, the data indicate a tendency of larger black populations to be more segregated. Similarly, while the measure is scale invariant, larger areas also tend to be more heavily segregated. Though these variables remain robust predictors of segregation in 2010, the impact of government fractionalization is now robust to their inclusion, with a doubling of local government density implying a 5 percent increase in the dissimilarity index of an otherwise similar MSA.

Table 3.9: Segregation and Government Fractionalization, 1970 and 2010

	(1)	(2)	(3)	(4)	(5)	(6)
	Log of the Dissimilarity Index for Black and Non-Black Residents					
		1970			2010	
Log of Local Governments	0.0427**	0.0529*	-0.0009	0.1203**	0.1089**	0.0513*
Per Square Mile, 1962	[0.0132]	[0.0235]	[0.0237]	[0.0198]	[0.0274]	[0.0219]
Log of Black Share of			0.0370**			
the Population, 1970			[0.0113]			
Log of Total Population, 1970			0.0946**			
			[0.0142]			
Log of Black Share of						0.1209**
the Population, 2010						[0.0366]
Log of Total Population, 2010						0.0793**
						[0.0156]
Constant	-0.4474**	-0.4496**	-1.5184**	-0.8845**	-0.8821**	-1.6038**
	[0.0195]	[0.0191]	[0.2024]	[0.0298]	[0.0273]	[0.2743]
Region Fixed Effects	NO	YES	YES	NO	YES	YES
Observations	221	221	221	221	221	221
R-squared	0.07	0.07	0.4	0.24	0.36	0.59

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Consistent tract level data comes from the Longitudinal Tract Database (http://www.s4.brown.edu/us2010/Researcher/Bridging.htm). Standard errors are clustered at the state level.

Table 3.10 confirms the growth of segregation over time, looking at the entire period in columns 1 and 2 and then showing the results for each decade. Controlling only for the initial level of segregation, the impact of government fragmentation on the growth in log dissimilarity is 9 log points, falling to 5 log points when controlling for the total population and the black share of the population in 1970, as well as adding region fixed effects. Subsequent columns show that this effect is particularly concentrated in the first two decades. In fact, the growth in segregation in the most recent period with all controls is a weak and insignificant negative value. Throughout the regressions I control for the size of the population and black share in the base year (so 1980 for the regression examining growth from 1980 to 1990) as the variables seem to have a direct impact on the contemporaneous level of segregation. Meanwhile, I control only for the 1970 level of segregation so as to measure long run convergence over the entire time period. Interestingly the negative coefficient on 1970 dissimilarity is strong throughout all four decades, though declining somewhat from 18 log points in the earliest decade to 11 log points in the most recent one. Thus, initially highly segregated areas have had particularly strong declines in segregation throughout the period, even on top of the large declines seen in all areas. Fractionalization has been pushing against the wind, albeit at a magnitude that has done little to diminish the declines across all areas.

Despite the fact that segregation is falling more slowly in highly fragmented areas, the black populations in these areas are if anything growing more quickly. Column 1 in Table 3.11 shows a regression of the growth of the log of the black share of the population on local government density and the black share in 1970. The impact of fractionalization is 14 log points and significant at the 1 percent level. This falls to just under 10 log points when adding controls for the manufacturing share, temperature variables and regional fixed effects, though this coefficient is not significant at the 5 percent level. The growth of the black share is consistently between 3 and 4 log points across the specifications with few controls, but is small and insignificant after the initial decade when more controls are added. While segregation may have negative impacts on black outcomes, as suggested by Cutler and Glaeser, higher levels of segregation in fractionalized areas does not seem to be driving away black residents.

Table 3.10: Growth in Black Segregation and Government Fractionalization, 1970 to 2010 and by Decade

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Change in Log Dissimilarity Index for Blacks and Non-Blacks									
	1970 to 2010		1970 to 1980		1980 to 1990		1990 to 2000		2000 to 2010	
Log of Local Governments	0.0917**	0.0505**	0.0319**	0.0317**	0.0273**	0.0161*	0.0252**	0.014	0.0074	-0.0119
Per Square Mile, 1962	[0.0166]	[0.0175]	[0.0074]	[0.0104]	[0.0055]	[0.0067]	[0.0088]	[0.0092]	[0.0068]	[0.0090]
Log of Dissimilarity	-0.3305**	-0.6612**	-0.0536	-0.1817*	-0.1213**	-0.1780**	-0.0652	-0.1487*	-0.0903*	-0.1088*
Index, 1970	[0.1067]	[0.0945]	[0.0665]	[0.0721]	[0.0365]	[0.0436]	[0.0549]	[0.0584]	[0.0414]	[0.0446]
Log of Black Share of the		0.0720**		0.0273**		0.013		0.0274*		0.0052
Population in Base Year		[0.0134]		[0.0084]		[0.0071]		[0.0116]		[0.0083]
Log of Total Population		0.0603**		0.0228*		0.0113		0.0128		0.0056
in Base Year		[0.0149]		[0.0090]		[0.0067]		[0.0080]		[0.0062]
Constant	-0.5850**	-1.2627**	-0.1519**	-0.4121**	-0.1502**	-0.2779*	-0.1426**	-0.2628	-0.1404**	-0.2029*
	[0.0455]	[0.2463]	[0.0274]	[0.1430]	[0.0198]	[0.1136]	[0.0190]	[0.1394]	[0.0154]	[0.0964]
Region Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	221	221	221	221	221	221	221	221	221	221
R-squared	0.21	0.55	0.1	0.32	0.17	0.23	0.09	0.35	0.04	0.09

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Consistent tract level data comes from the Longitudinal Tract Database (http://www.s4.brown.edu/us2010/Researcher/Bridging.htm). Standard errors are clustered at the state level.

Table 3.11: Growth in the Black Share of the Population and Government Fractionalization, 1970 to 2010

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Change in Log Black Share of the Population									
	1970 to 2010		1970 to 1980		1980 to 1990		1990 to 2000		2000 to 2010	
Log of Local Governments	0.1421**	0.0957	0.0413	0.0702	0.0323**	0.0062	0.0335**	0.0182	0.0350**	0.0011
Per Square Mile, 1962	[0.0431]	[0.0534]	[0.0341]	[0.0505]	[0.0104]	[0.0134]	[0.0118]	[0.0187]	[0.0115]	[0.0132]
Log of Black Share of the	-0.4349**	-0.4321**	-0.1289*	-0.1579	-0.0710**	-0.0450*	-0.1359**	-0.1369**	-0.0991**	-0.0923**
Population, 1970	[0.0492]	[0.0983]	[0.0521]	[0.0910]	[0.0126]	[0.0190]	[0.0176]	[0.0168]	[0.0140]	[0.0186]
Log of Manuf. Share		0.0529		0.0424		-0.005		-0.0128		0.0282
of Employment, 1970		[0.1024]		[0.0806]		[0.0273]		[0.0278]		[0.0349]
Log Mean January Temp,		-0.4234		0.3458		-0.2494**		-0.2603**		-0.2595**
1961-1990		[0.3501]		[0.3509]		[0.0688]		[0.0797]		[0.0871]
Log Mean July Temp,		0.3741		-1.036		0.1393		0.6648**		0.6060**
1961-1990		[0.8993]		[0.8458]		[0.1310]		[0.2295]		[0.2100]
Constant	-0.7937**	-0.8465	-0.2922*	2.9738	-0.1372**	0.2017	-0.2092**	-2.2101**	-0.1551**	-1.8119*
	[0.1401]	[4.0845]	[0.1379]	[3.2849]	[0.0332]	[0.6747]	[0.0488]	[0.7974]	[0.0369]	[0.8535]
Region Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	228	228	228	228	228	228	228	228	228	228
R-squared	0.69	0.71	0.18	0.22	0.44	0.54	0.59	0.66	0.56	0.65

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Temperature data is from 1994 City and County Data Books. The remaining data comes from the US Census. Standard errors are clustered at the state level.

Finally I turn to the implications of fractionalization for urban sprawl. Advocates of regionalism often express concern about decentralization and the tendency of recent development to be on the fringes of urban areas, and suggest that regional governance can be a tool for shaping an MSA's footprint. While the normative implications of sprawl are beyond the scope of this paper, I can nonetheless examine whether government fractionalization has impacted the density of urban development over the past 40 years.

Defining metrics for sprawl has been a challenge for the literature (see Galster et al. (2001) for discussion of several alternatives) but following Glaeser and Kahn (2004) I will use density gradients for residence and employment, estimated as the coefficient returned from running a regression of log density on distance from the central business district. For central business district location I follow Holian and Kahn (2012) in using the point returned by Google Maps when performing a search for the primary city of an MSA. As I am using centroids of census tracts to determine location, I limit myself to the 93 MSAs with over 500,000 residents in 2010 to improve precision in the density regressions. Census tract residence again comes from the Longitudinal Tract Database, and employment comes from the Zip Code Business patterns matched to census tracts using the HUD zip code to census tract crosswalk. Unfortunately the Zip Code Business patterns have only been available since 1994 and the HUD crosswalks began only quite recently, so I forego a time series and merely examine the 2010 cross-section. For residential density I am able to look across the entire 40 year period.

Table 3.12 presents the cross-sectional relationships for 1970 and 2010 residential density and for 2010 employment density. A more negative value of the density gradient implies a greater level of centralization, as density is sloping down more quickly moving away from the city center. Columns one and two show the impact of government fractionalization on residential density in 1970 with and without region fixed effects. The coefficient is positive, implying that more fractionalized MSAs are more sprawled, and this impact is stronger when regional fixed effects are included. Adding controls for manufacturing share and temperature variables reduces the coefficient somewhat and renders it insignificant. Turning to 2010 in columns 4 through 6, similar patterns emerge, though the coefficients are generally smaller. The coefficients on employment density in column 7 through 9 are stronger and the impact of government fractionalization is significant across specifications. In the full specification in column 9, a doubling of local government density leads to a 4.34 percent larger (less negative) employment density, suggesting less clustering of economic activity in the city center.

The changes over time in the impact of government fractionalization on sprawl are small and generally insignificant, as shown in Table 3.13. This would seem to suggest that fractionalization has had little impact on the growth in residential sprawl over the last 40 years. Being able to look at the time series for employment would be interesting, as the 2010 cross-section suggests a potential role for fractionalization in employment decentralization, but drawing conclusions from that single data point is difficult.

Other measures of sprawl may well show differing impacts, though Burchfield et al. (2006) reach a similar conclusion when examining the impact of government fragmentation on their measure of sprawl which uses aerial photography to measure increases in density from 1976 to 1992. While their count of local governments shows little relationship with sprawl, they do point to intergovernmental transfers that finance infrastructure to outlying development as being positively related to sprawl. This type of transfer, usually coming from county or state governments, is regional in nature, but it is presumably not what most regionalists concerned with sprawl have in mind when they argue for greater regional coordination of development. As was the case with urban growth, the lack of a strong relationship between broad measures of government fractionalization and the growth in sprawl does not mean that a well-tailored regional policy might not have a large impact. It suggests, however, that regional governance or a lack thereof, does not inherently lead to more compact urban areas.

Table 3.12: Urban Sprawl and Government Fractionalization, 1970 and 2010

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Density Gradient								
	Residential, 1970			Residential, 2010			Employment, 2010		
Log of Local Governments	0.0196	0.0461**	0.0354	0.0005	0.0194**	0.0214*	0.0185*	0.0401**	0.0434**
Per Square Mile, 1962	[0.0099]	[0.0108]	[0.0204]	[0.0036]	[0.0067]	[0.0086]	[0.0076]	[0.0120]	[0.0121]
Log of Manuf. Share			0.0711			0.0275			0.0364
of Employment, 1970			[0.0461]			[0.0222]			[0.0324]
Log Mean January Temp,			0.2597*			0.1019*			0.2004**
1961-1990			[0.1003]			[0.0421]			[0.0581]
Log Mean July Temp,			-0.1354			0.0847			0.0538
1961-1990			[0.3086]			[0.1267]			[0.1605]
Constant	-0.2138**	-0.2222**	-0.4471	-0.1149**	-0.1209**	-0.8111	-0.1787**	-0.1855**	-1.0792
	[0.0220]	[0.0191]	[1.5203]	[0.0092]	[0.0077]	[0.6041]	[0.0147]	[0.0127]	[0.7616]
Region Fixed Effects	NO	YES	YES	NO	YES	YES	NO	YES	YES
Observations	93	93	93	93	93	93	93	93	93
R-squared	0.03	0.08	0.21	0	0.08	0.19	0.05	0.08	0.23

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Consistent tract level data comes from the Longitudinal Tract Database (http://www.s4.brown.edu/us2010/Researcher/Bridging.htm). Employment data comes from the Zip Code Business Patterns, matched to tracts using HUD crosswalks (http://www.huduser.org/portal/datasets/usps_crosswalk.html). Standard errors are clustered at the state level.

Table 3.13: Change in Residential Density Gradient and Government Fractionalization, 1970 to 2010

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Change in Residential Density Gradient									
	1970 to 2010		1970 to 1980		1980 to 1990		1990 to 2000		2000 to 2010	
Log of Local Governments	-0.0073*	0.0074	0.0034	0.0059	0	0.0041*	-0.0032**	0.002	-0.0076**	-0.0046
Per Square Mile, 1962	[0.0031]	[0.0039]	[0.0023]	[0.0049]	[0.0016]	[0.0018]	[0.0011]	[0.0025]	[0.0017]	[0.0047]
Density Gradient, 1970	-0.6032**	-0.6030**	-0.2850**	-0.3006**	-0.1241**	-0.1320**	-0.0962**	-0.0909**	-0.0978**	-0.0795**
	[0.0261]	[0.0248]	[0.0192]	[0.0421]	[0.0133]	[0.0362]	[0.0089]	[0.0128]	[0.0146]	[0.0157]
Log of Manuf. Share		-0.0007		0.0052		0.0046		-0.0044		-0.0061
of Employment, 1970		[0.0163]		[0.0121]		[0.0050]		[0.0045]		[0.0076]
Log Mean January Temp,		-0.0012		0.0125		0.0143		-0.004		-0.0241*
1961-1990		[0.0138]		[0.0120]		[0.0076]		[0.0051]		[0.0100]
Log Mean July Temp,		0.1385		-0.1007		0.0428		0.0742		0.1221
1961-1990		[0.1341]		[0.0647]		[0.0446]		[0.0400]		[0.0665]
Constant	-0.0301**	-0.6337	-0.0262**	0.3708	-0.0041	-0.2372	-0.001	-0.3168	0.0012	-0.4505
	[0.0068]	[0.5524]	[0.0050]	[0.2588]	[0.0035]	[0.1835]	[0.0023]	[0.1734]	[0.0038]	[0.2758]
Region Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	93	93	93	93	93	93	93	93	93	93
R-squared	0.86	0.89	0.71	0.75	0.5	0.59	0.61	0.67	0.46	0.54

Notes: Metro areas are consistently defined using the 1999 definitions for MSAs, CMSAs and NECMAs. Town and municipal government data come from the 1962 Census of Governments. Consistent tract level data comes from the Longitudinal Tract Database (http://www.s4.brown.edu/us2010/Researcher/Bridging.htm). Standard errors are clustered at the state level.

3.5 Conclusion

The number of municipal and town governments in urban areas has barely budged over the last 50 years, leaving large differences across areas in the rate of fractionalization of local government largely unchanged. Should we worry that places with more or less fragmented government might be falling behind? The experience of the last 40 years suggests this is not likely to be the case. On core metrics of urban performance such as population and income growth neither governance structure shows much advantage compared to the other once a modest set of controls is introduced. Fractionalized areas seem to be slightly more attractive to college educated workers, but have seen segregation fall somewhat less rapidly. On issues of sprawl and land use policy, often focuses of discussions of regional policy, little difference is observed between places with differing concentrations of local governments.

This is not to say that regionalism has no role to play in urban policy. Certainly the results on racial segregation bear watching, and further research on the role of government fragmentation in the recent growth of economic segregation documented by Bischoff and Reardon (2011) is warranted. Understanding more about what is driving the correlation between growth in the share of bachelor's degree holders and fractionalization takes on increasing importance in a world in which city size and city skill level seem increasingly complementary (Abel et al., 2012).

Furthermore, as cities face differing challenges, different tools are often necessary. In the early twentieth century, when rapidly expanding access to secondary education was the primary local responsibility, the flexibility of small fractionalized school districts throughout much of the country allowed America to pull ahead of more centralized approach pursued in Europe. On the other hand, in the late 19th century, when a lack of access to clean drinking water plagued many of the nation's urban areas, a regionally coordinated approach was more effective at providing the most urgently needed local public good (Cutler and Miller, 2005).

In both these cases, local government took the form not only of municipal and local governments, but also of school districts and special districts that did not fit tightly within already established borders. Perhaps one explanation for the limited impact of town and municipal government density over the last half century is that these more flexible forms of governance arise when needed to tackle challenges that extant local governments are unable to handle. Of course regional water authorities do not arise out of thin air - they require the types of coalition building and coordination that is the focus of much work on regionalism. The broad picture painted here may obscure these more complicated underlying dynamics. Nonetheless, by disentangling the impact of regionalism from other broad economic forces playing out across US metro areas, the results presented here caution against interpreting the strong growth of some highly regionalized urban areas as evidence for the overall dominance of regional governance over recent decades.

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Appendix A

Appendix to Chapter 1

A.1 Defining Sub-Regions of Greater Boston

In defining four regions to analyze heterogeneity in the treatment effect across different types of jurisdictions, I aimed to create four regions that were relatively internally consistent in their composition but that provided contrasts with each other. While I largely followed pre-defined county and New England City and Town Area (NECTA) division lines, I exerted some judgment given knowledge of the area to come up with the specific lists of cities.

1) The Urban Core - I define the urban core as the city of Boston and any city that falls within 5 miles of the city's political and economic center in Northeast Boston. In practice nearly all of these cities fall to the north, and are generally a set of racially integrated suburbs. This set of 10 municipalities includes Brookline, Boston, Cambridge, Chelsea, Everett, Malden, Medford, Somerville, Winthrop, and Revere.

2) The Route 128 Corridor - Route 128, which runs concurrently with Interstate 95 in the Boston metro area, is the inner of the 2 circumferential highways, circling the city center at a distance between 10 and 15 miles. It runs through or near many of Boston's wealthiest suburbs and is a hub of high tech employment. I use suburbs that fall just inside or outside the road from its origin just south of the city to the edge of Essex County. This set of 27 towns includes Arlington, Bedford, Belmont, Burlington, Concord, Lexington, Lincoln, Melrose, Natick, Newton, North Reading, Reading, Sudbury, Stoneham, Waltham, Wakefield, Watertown,

Wayland, Weston, Wilmington, Woburn and Winchester in Middlesex County and Dedham, Dover, Needham, Wellesley, and Westwood in Norfolk County.

3) I define the Northern Suburbs as encompassing all of Essex County with the exception of the far northern coastal communities that have little in common demographically and economically with their neighbors. The 22 towns in this group are Andover, Beverly, Boxford, Danvers, Georgetown, Groveland, Hamilton, Haverhill, Lawrence, Lynn, Lynnfield, Marblehead, Methuen, Middleton, Nahant, North Andover, Peabody, Salem, Saugus, Swampscott, Topsfield, and Wenham.

4) The Southern Suburbs extend south from the city limits to Brockton, Massachusetts. The 18 towns included are Abington, Avon, Braintree, Bridgewater, Brockton, Canton, East Bridgewater, Easton, Holbrook, Milton, Norwood, Quincy, Randolph, Sharon, Stoughton, West Bridgewater, Weymouth, and Whitman.

Appendix B

Appendix to Chapter 2

B.1 Data Appendix for Chapter 2

For Figures 2.1, 2.3 and 2.4, and Equations 2.1 and 2.2, productivity (or output per worker) is calculated by dividing the Gross Metropolitan Product for 2001 (from the Bureau of Economic Analysis at http://www.bea.gov/regional/gdpmetro/) by the total labor force for 2000 (from published 2000 Census figures). Population and share with BAs also comes from the published 2000 Census figures, and this population and BA data are also used in Figure 2.2. For Figure 2.3, Less Skilled Metropolitan Statistical Areas (MSAs) refer to those MSAs that have the share of the population with BAs in 2000 less than 17.64 percent. For Figure 2.3, More Skilled MSAs refer to those MSAs that have the share of the population with BAs in 2000 more than 25.025 percent. For Equation 2.3, population and share with BAs in 1940 comes from published 1940 Census figures. For Equation 2.7, population in 1900 comes from published 1900 Census figures. For Equation 2.4, real family income is calculated using family median income from the published 2000 Census figures, divided by the cost-of-living index for each MSA published by the American Chamber of Commerce Research Association at http://www.coli.org/. Data for Figure 2.5 are calculated using the 2006 Annual Survey of Manufactures, with details described in the paragraph about Table 2.2 below.

The individual-level data used in Tables 2.1 and 2.3 come from the Integrated Public UseMicrodata Series (IPUMS) 2000, five percent Census sample. Where aggregate metro-area numbers such as population and the percentage of workers over 25 with a college degree are used in conjunction with individual-level data, these are merged on from published Census figures, since the IPUMS does not fully identify all metro areas. All individual-level regressions are run for male workers aged 25 to 65. Hourly earnings are calculated by dividing yearly earned income by number of weeks worked and usual weekly hours. Experience is calculated as age minus years of schooling minus six, where years of schooling is approximated as precisely as possible using the categorical schooling variable provided in the 2000 Census. All calculations are weighted by person weight unless otherwise noted.

In Table 2.2, the state-level log capital per worker, log value added per worker and log hourly wage were calculated using the total capital expenditures, total value added, number of employees, total production workers wages, and total production workers hours data from the 2006 Annual Survey of Manufactures at factfinder.census.gov. The state-level density and years of schooling variables come directly from Table 2 of Productivity and the Density of Economic Activity by Antonio Ciccone and Robert E. Hall, American Economic Review, March 1996.

Data for Table 2.4 come from the General Social Survey. In 1994, eight reasoning questions were asked that required the respondent to assess the similarities between various objects and ideas. Their responses were coded as correct, partly correct, or incorrect by the GSS, and information on this coding is available in Appendix D of the GSS cumulative codebook. Our dependent variable is the number of fully correct responses out of the eight questions. The vocabulary test, given in 17 waves of the survey spaced between 1974 and 2006, asks the respondent 10 vocabulary questions and records the number of correct responses. We pool across the waves, weighting using the WTSSALL variable which, which adjusts for the ways that the counting of households in the survey has changed over time. For the residence variables, categories of xnorcsize (current residence) are combined so as to mirror the categories of the res16 (residence at age 16) variable as closely as possible.